

THE ENGINEERING RECORD

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

MAIN OFFICES:

114 LIBERTY STREET, NEW YORK.

BRANCH OFFICES:

PHILADELPHIA: 929 Chestnut Street.

CHICAGO: 1140 Monadnock Block.

CLEVELAND: Cuyahoga Building.

LONDON OFFICE: Hastings House, Norfolk St., Strand.

SUBSCRIPTION RATES:

United States, Canada, Cuba and Mexico....\$3.00 a year.
Foreign subscription 6.00 a year.
25 shillings. 25 marks. 31 francs.
Foreign subscriptions may be sent to our London office.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of THE ENGINEERING RECORD by 10 A. M. Monday of the week of issue. New advertisements can be received up to noon of Wednesday of the week of issue.

NOTICE TO SUBSCRIBERS.

REMITTANCES.—Remittances should be made by check, New York draft, or money order, in favor of THE ENGINEERING RECORD.

CHANGE OF ADDRESS.—The old address should be given as well as the new, and notice should be received a week in advance of the desired change.

BACK COPIES.—No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Entered at the New York Post-Office as Second Class mail matter.

Copyright, 1905, by the McGraw Publishing Co.

Of this issue of THE ENGINEERING RECORD 12,000 copies are printed. Total circulation for 1905 to date, 442,500 copies.

TABLE OF LEADING ARTICLES.

The Board of Consulting Engineers of the Isthmian Canal Commission	281
Laboratories in Industrial Works.....	281
Cholera in Europe	282
The Cost of Engineering Work.....	282
Concrete Viaduct at Riverside, Cal. (Illustrated)...	284
The New Waterside Station of the New York Edison Co. (Illustrated)	287
The Classification and Peculiarities of Steam Turbines	291
Concrete Plant for the Brooklyn Anchorage of the Manhattan Bridge (Illustrated).....	293
A Reinforced Concrete Double-Track Railroad Bridge (Illustrated)	295
Progress on the Battery Tunnel, New York (Illustrated)	297
Experiments with Models of Dams (Illustrated)....	298
New Turbo-Generator Plants of the Clyde Valley Electrical Power Co., Ltd. (Illustrated).....	299
The Scioto River Storage Dam at Columbus, O. (Illustrated)	302
Erection of the St. Anne's Bridge (Illustrated)....	305
Book Notes	306
Properties of Circles	307
A Mill Building Problem.....	307
Shearing Stresses in Masonry.....	307
Steam Turbine Pumps for Water-Works.....	306

The Board of Consulting Engineers of the Isthmian Canal Commission.

In accordance with the program already announced the Board of Consulting Engineers to advise the Isthmian Canal Commission regarding the plans for the Panama Canal convened in Washington on Sept. 1. The discharge of their duties involves extraordinary responsibilities. The construction of a ship waterway across the American isthmus between the two oceans is the greatest single engineering work ever undertaken. It is not subject to the restricting conditions which ordinarily hedge about a private corporate enterprise, or at any rate it is not restricted to nearly the same degree. It is absolutely essential and fundamental that no money be wastefully or, above all, corruptly expended; but it may easily be a radical error to make the least first cost a controlling

element in any main feature of the canal problem. This is probably the most important general consideration bearing upon any part of the entire work before the Board and the present Canal Commission. The least first cost leads to cheapness, but cheapness is seldom economy. The cost of any practicable type of canal of ample capacity is no burden to the United States government, provided the work is honestly and efficiently done. The government may well build even the costliest form of ship canal if it secures the worth of its money.

Doubtless this eminent Board will take a large view of the great problem before it, but there is such a strong tendency among engineers to allow the estimated cost in dollars to outweigh value expressed in any other unit that too much insistence upon a liberally economic view of the controlling elements of this Isthmian Canal business is scarcely possible. Extravagance must not be tolerated in public works, but any close paring down of the cost of this canal at the expense of free and safe navigation, or of ample prism or by sensible restriction of capacity from any cause whatever, or to accomplish such a secondary result as a "quick" opening, would be most reprehensible. Fortunately for the Board a number of its members are already thoroughly familiar with both salient features and details of the entire problem so that they bring to the performance of their duties views developed under extended experience with the things to be considered.

The letter to the Board from the Commission by its President, accompanying the papers and documents submitted, has been published apparently in full by the daily papers. It would seem that such a letter, so far as it relates to the duty of the Board, would be written without prejudice and free from any attempt to shape or influence in any way the Board's conclusions, and be made simply a vehicle for conveying to it fully and evenly all existing data requisite for fair and deliberate conclusions. It is more than surprising therefore, to find the following remarkable paragraph in the letter of transmission:

"During the last year additional surveys and observations have been made upon the isthmus, the results of which are laid before you. It may be stated here in general terms that the information which they furnish does not involve any radical change in the plans previously favored. Among the observations alluded to may be included the experience of the last year in excavating the Cullebra cut, from which some of our engineers have drawn unwarranted conclusions as to the probable cost of the work. There is nothing in this experience to justify the belief that the unit prices used in previous estimates were too high, or that the estimate of the time required for completing the work was too liberal. Nevertheless, this experience has been used as an argument in favor of a sea-level canal, which plan had been condemned by the two commissions mentioned above. It becomes necessary to consider once more the sea-level scheme."

The most casual reader cannot fail to receive the impression from this language that the Commission is attempting to shape the Board's conclusions as to some of the principal features of its work by laying down the dictum that the results of the past year's investigations do "not involve any radical change in the plans previously favored." It is a fair assumption from this language that the Commission is endeavoring to induce the Board to endorse "the plans previously favored," meaning, presumably, the tentative lock canal plans of the old Isthmian Canal Commission.

Furthermore, it will be observed that the Commission in this paragraph warns the Board against the "unwarranted conclusions" drawn by "our engineers" from the investigations carried on during the past year. It appears from the latter portion of the paragraph that these unwarranted

conclusions are taken "in favor of a sea-level canal." Presumably these conclusions which have thus come under the official ban of the Commission are those of former Chief Engineer Wallace and of the Engineering Committee of the previous Commission.

It takes no difficult reading between the lines of this part of the Commission's letter of transmission to learn that the present Isthmian Canal Commission has already concluded against a sea-level canal, for that much is stated in substance in the above quoted paragraph.

The Engineering Record is not interested in advocating any type of ship canal at Panama. If a lock canal can best serve the public interests of this country, then by all means let that type be adopted; if on the other hand a sea-level canal can be shown to be on the whole the best adapted to the broad purpose of a ship canal across the Isthmus, even though it cost more money and require more time to construct, no prejudice or preconceived ideas of the present Isthmian Canal Commission should be allowed to defeat the adoption of sea-level plans. This apparent attempt to subject the Consulting Board to prejudiced influence at the very outset of its work is most unfortunate. The Commission has apparently come dangerously near to a successful impeachment of its own fairness, calculated to undermine public confidence in its work.

Undoubtedly the Board of Consulting Engineers will proceed to the performance of its duties with complete independence of every effort to influence its conclusions. It owes that duty to the President and to the American public. Every scrap of substantial evidence, whether obtained from the investigations of the past year or from the operation of the old Panama Canal Company, or from any other source should be carefully scrutinized and given due weight. It matters little whether the United States Government pays \$200,000,000 or \$300,000,000 as the total cost of the Canal, or whether the Canal is opened in ten years or in fifteen years, provided the results secured are honestly worth the money and the time required to obtain them. Whether a lock canal or a sea-level canal be the waterway ultimately constructed let the Board of Consulting Engineers make an absolutely complete and fair study of all the evidence available, free from all prejudice or other improper influence and then let the Canal be constructed in an efficient and business-like manner under a steady and well-balanced policy.

Laboratories in Industrial Works.

The value of scientific research is to-day conceded by every liberal-minded business man, and the tendency to scoff at so-called theoretical experiments and labors is seldom encountered in enlightened circles. This broadened mental temper is particularly noticeable in the higher classes of engineering work and it is gratifying to see the appreciation with which the laboratory is now regarded by the executives and the technical advisers of many large commercial enterprises. Perhaps there is to-day a wider realization than ever before of the fundamental laws and principles which lie at the cornerstone of the industrial fabric, and although the reports of the chemist and the physicist are seldom circulated outside the client's premises, the test tube and the microscope play an important part in many large contract awards.

Industrial laboratories may be classified according to the work performed, into two divisions; research and testing plants. In enterprises like the manufacture of electrical machinery, where obscure phenomena require regular investigation to insure a standard quality of product, the testing department is an absolute necessity, and in

the elaborate buildings and equipment erected for this purpose at Schenectady, Pittsburg and similar industrial centers, we find the largest commercial testing laboratories of the present time. The importance of the work performed here is beyond question, and if purchasers would avail themselves more generally of the privilege of sending representative experts to be on the spot as their equipment goes through the factory test, there is no doubt that in many cases a large amount of needless repetition and expense would be saved in the conduct of subsequent service tests. It is also frequently of advantage to the manufacturer to have the criticisms and suggestions of the outside engineer during the test period, for however searching may be the attitude of the regular testing force, the specialized interest of the purchaser's representative may easily bring to light points which might naturally escape the factory staff in its routine duties. It is scarcely necessary to say that the outside man must possess both tact and expert knowledge to be of much use to his clients, and the practice of sending inexperienced employees to witness factory tests is a sheer waste of money.

As for the research laboratory, the conditions often enable it to be operated in conjunction with the regular testing department, but in such cases it is desirable that the heavy pressure of commercial testing shall not be allowed to crowd out the investigation work. The organization and conduct of affairs need to be very carefully worked out before researches and 24 hours-per-day commercial tests can be successfully carried on under the co-operative plan. It is natural in these days to look at results, and it is not always easy to see \$500 or \$1,000 per month going into research work in a large company without sometimes wondering if the game is worth the candle. But under modern conditions of industry it is doubtful if any company whose product represents the combined work of many specialists and the united properties of many variable materials can afford to overlook the possibilities of the research laboratory in improving the economy of production. In some cases the laboratory is better off under outside management, while in others the maximum usefulness will be derived from its location upon the company's own premises. No greater mistake can be made than to assume that the end of progress in any particular field is in sight, and that research is a needless luxury. The possible discovery of new combinations of materials which will result in largely increased profits is never absent; and the ability to investigate, at first hand, schemes for meeting competition is worth much in these days of systematic analysis of everything from the office boy's use of the telephone to the transportation charges upon the finished product. In a large establishment the calibration of instruments and the production of fixed standards are often questions that must be solved without the delay of shipping to other manufacturers for comparisons. Here and in accurate work of every kind bearing upon delicate equipment the laboratory may be of far-reaching value.

Once a research laboratory is established in an industrial plant, however, it should be run on business principles if the maximum good is to accrue from its maintenance. There should be regular hours of work, a definite and sub-divided expense account, systematic filing of research and test records, and periodical reports of what is being done. Employees at large should not be permitted to wander about the premises at will, and although the department may work for months without appearing to produce valuable results from its researches, the phenomena and materials investigated and the negative points ascertained should be kept in such shape that the company can, at least, see that some return for its money is being made. In the great majority of cases,

from the railroad system to the factory, results of positive value will be derived from a properly equipped and conducted laboratory, and there is no question that the future will witness a much more extended development along the lines of research for the sake of commercial ends.

Cholera in Europe.

The outbreak of cholera in Europe is an incident that need cause no apprehension in the United States and very little in Europe. In the thirteen years that have passed since the last serious outbreak a great deal has been learned concerning the cause, treatment and prevention of the disease. In many respects it is like typhoid fever, differing mainly in the rapidity of its course and its fatality. It is spread in the same way, but much more quickly and widely, and for this reason every patient must be watched vigilantly in order to prevent any dissemination of the germs of the disease.

In the last century it was not uncommon. There were epidemics in London in 1832, 1848, 1853, 1854 and 1866 before health officers generally recognized that the disease is water-borne. In 1854 positive proof was furnished that a public well was the cause of a death rate from cholera of 220 per 10,000 in a single parish. In 1866 the epidemic was first detected in a case in Bristol, imported from Rotterdam. A little later some emigrants to New York from infected places on the Continent developed the disease while their ship was in the Mersey. Soon afterward cases were reported in other seaports and in three months a large number appeared in East London. It was soon noticed that the disease was most prevalent in districts supplied with water from the River Lea. Part of this water was filtered and part was not. From what is now known concerning the remarkably easy way in which the disease spreads, as compared with typhoid, there is every reason for stating that the deaths in London were due to an infection of the water supply from one of the many cases brought from the Continent.

That it can be very largely prevented by avoiding the use of contaminated water is positively proved by the experience of Hamburg and Altona, two cities that are practically one save for administrative purposes. In 1892 some emigrants on ships bound to America developed the disease and infected the Elbe, where the vessels were lying. The Elbe water was pumped from the river directly into the mains supplying Hamburg, but was filtered before it was delivered in Altona. Consequently while the epidemic swept through Hamburg it left Altona untouched. These and many other occurrences are ample proof, outside of the investigations of bacteriologists, that cholera is spread by polluted water and possibly by food supplies polluted by flies.

The history of the present outbreak is typical. It began in Arabia and spread across Syria, Mesopotamia and Persia into Russia; then it went up the Volga into the heart of that empire. Sanitation is little known among the Muscovites and the death rate in their cities is always so high that what would be considered an epidemic in most countries attracts little attention, particularly if the people afflicted are the laboring classes. It was carried into East Prussia, but there it found competent medical barriers and has since been fought intelligently. On September 1 there were 43 cases in Germany, all in East Prussia save one in Hamburg. The imperial government at once ordered all emigrants from the country to be kept under quarantine regulations until it was certain they were healthy, and the United States Marine Hospital Service sent its inspector at Naples to Hamburg and ordered another inspector from Philadelphia to go to his assistance. On September 2, a second case was discovered at Hamburg and 19 deaths were reported. On Sep-

tember 4 the number of cases had risen to 66 and the deaths to 23, and on September 5 these figures were 77 and 24 respectively. The disease was brought into the country by Russian raftsmen who came down the Vistula River, and by a party of eighty emigrants, one of whom was the man who first died in Hamburg. As soon as this fact was known, orders were issued closing all restaurants along the Vistula, except in towns, so that the rivermen can be kept under better supervision, and facilities were provided for treating cholera patients in many parts of the empire. The sanitary police powers were greatly extended five years ago, and no fear need be felt but that every precaution will be taken to sequester all suspected of having the disease.

There is very little chance that the disease will be introduced into the United States from Germany, although it is barely possible that a few cases may come in by way of Trieste, as cholera has appeared in Austrian Poland, which sends many emigrants to this country by way of that city. It must be remembered, however, that the disease develops in five days, and it is hardly possible for any one afflicted with it to reach this country except in a condition that would be immediately detected by the quarantine officers. The only danger is in the possibility of cases being smuggled in through the connivance of ship owners and friends.

This outbreak, like that of yellow fever in New Orleans, suggests the desirability of having in the United States some such national authority over these epidemic diseases as is afforded by the German sanitary police regulations. As soon as cholera was detected in Germany the imperial authorities assumed charge, men of international reputation were brought into consultation, and everybody is confident that all measures of any utility will be rigidly enforced. At New Orleans, on the contrary, the presence of yellow fever was hushed up until it was well established and then all sorts of silly performances were indulged in until the Marine Hospital Service took charge of the situation with a firm hand. Rich and poor alike invited death by careless disregard of sanitary precautions and had to be fined and imprisoned before they were brought to a realization of their criminal carelessness. It seems hardly conceivable that in this enlightened age, in a country boasting of the education of its masses, the laws are so inadequate and public officers so lax and ignorant that a man is allowed to keep his premises in such a condition as to be a menace not only to himself but also to the entire community. Yellow fever, typhoid fever and cholera are all preventable, and their ravages are so serious that strong laws and ample police powers to enforce them ought to be provided and used everywhere.

The Cost of Engineering Work.

Articles in this journal last week have brought comments from a number of readers, which again call to mind the very important part that a study of costs ought to play in most engineering plans. It is, of course, essential always to bear in mind that first cost is but a single item in the grand total of expenses. Cost of maintenance, of operation, of replacement and of inconvenience due to inadequate facilities must be all considered in the light of the special conditions of the work in hand. Take, for example, the Rhodesia Ry., which is being carried northward from the Zambesi. Its gauge is one that most American railway officials consider a sign of benighted ignorance, but there can be no question about the high engineering ability of the engineers who have selected it. The 3½-ft. gauge is employed throughout South Africa and has been found ample for the traffic, so that not only was there no reason for changing it, but convenience in running through cars from Cape

Town to the rail end demanded its adoption. The cost of the construction has been kept down to £3,000 per mile for this line, although heavy rails, steel ties and other expensive track details have been employed, and it is doubtful if any valid reason whatever could be found for the adoption of the more expensive gauge of 4 ft. 8½ in. Indeed, very good reasons exist in some localities for a gauge of even smaller width than that of the Cape Government system. For example, take the case of Sierra Leone, with 210 miles of shore frontage and only 30,000 square miles of territory, surrounded by the great possessions of other countries. The call for a railway is mainly military and civilizing, for there are very few products to be transported to the coast in any quantity. Consequently it was necessary to build as cheaply as consistent with permanence, and a gauge of 2½ ft. was adopted, for there are no roads with which it can connect and the desirability of providing for through cars need not be considered. The road is 222 miles long, laid with steel ties and 28-lb. rails. The ruling grade is 1:50 and the maximum curve has a 5-chain radius. Such a road does not have very much in keeping with text-book principles, yet it is safe to say that Sir Benjamin Baker, Sir William Shelford and Mr. Frederic Shelford, the consulting engineers, and the large staff of resident engineers, knew what they were about when planning the line.

Another line of thought is suggested by last week's article on the purification of water by ozone. This method of treatment has now been earnestly advocated by European makers of electrical apparatus and independent inventors for a good many years and has been introduced for purifying the water supplies of a few small communities. There seems to be no question about its efficiency when carefully managed, but until actually definite information about its cost is secured, it is idle to expect it to be seriously considered for the purification of water supplies for American cities. Our people are accustomed to a lavish use of water and allowance must be made for this custom. Any purification plant intended to treat large supplies must have considerable reserve capacity and inevitably demands skilled attendance. It is idle to expect engineers to accept without question some of the statements concerning the cost of the ozone treatment which have been put forward in good faith by its friends. Estimates of such cost based on experimental work on small quantities of water in well-equipped laboratories are useful, but their application to large plants is decidedly difficult. There is doubtless to be a considerable application of the ozone process in the United States before long, but it will probably come about at first through the purification of small supplies for industrial purposes. These can be studied by specialists, and as soon as sufficient information is obtained warranting the treatment of a municipal supply it is not unlikely that the system will be adopted for such a purpose. As before stated, the matter is more one of cost than efficiency.

Still another line of thought is suggested by Mr. Finkle's paper on the most economic type of hydraulic power conduits and Mr. Crafts' article on the reconstruction of the flumes on the Turlock Canal. These bring out strongly the importance of permanent construction as a saving in total expense. There are some engineering works that must be essentially experimental and hardly deserve to be executed in permanent materials until their best form is ascertained. As a rule, however, it is known when the plans are drawn what is the best construction for any detail, and all other constructions should be judged by comparison with it. The total annual cost of the work when built in the best way is the criterion by which other methods of construction must be judged. The latter may be cheaper in first cost, but they will entail higher maintenance charges

and may cause expensive delays in operation. This last factor is one difficult to estimate in dollars and cents, but it is a most important one in connection with all power plants and waterworks. In fact, a shut down of a central power plant for a day or so at a time will probably be sufficient cause for a failure to secure many important customers to whom reliability of service is highly desirable. The importance of this reliability was specifically mentioned by Mr. Bibbins in his article on the turbo-electric drive in paper mill service.

Other articles, notably that on the Barossa dam, which were printed last week also suggest very forcibly the importance of the cost element in engineering work. It is therefore not inappropriate to call attention again to the subject, because it is one that is not taught at all in most technical schools. The safety of structures is important, but it is also necessary to consider the cost of different methods of attaining the same result, and to bear in mind that there may be occasions when standard practice is wasteful and standard designs are needlessly expensive. Independence in designing is important, provided it is coupled with full knowledge of the cost of departure from standard practice, which, in civil engineering has become largely routine.

Notes and Comments.

ASPHALT LAID ON CONCRETE rarely bonds with it sufficiently to prevent tearing off the asphalt later in sheets. A Boston contractor decided to take advantage of this fact for waterproofing some centers used for concrete. The asphalt was spread over the centers and the concrete poured over it. On removing the centers when the concrete had set, the latter adhered to the asphalt so strongly that large pieces of the concrete were drawn out. It therefore appeared that concrete applied to asphalt would bond, although asphalt applied to concrete would not.

CHEMICAL ENGINEERING has reached a position of such distinctive importance that the University of Wisconsin has organized a course intended to give a training particularly along its lines. It is under Prof. Charles F. Burgess and requires five years for its completion, the fifth year being practically equivalent to post-graduate work. Specialization along narrow lines is not encouraged in under-graduate work, but a certain amount of attention is paid to the correlation of chemistry and engineering in solving practical problems by scientific methods rather than empirical rules.

THE BOUNDARY MONUMENTS recently placed on the line between Philadelphia and Delaware counties, Pa., are granite stones 4 ft. long and dressed 10 in. square above ground. They are set 2 ft. in the ground, according to a report by Chief Engineer Geo. S. Webster, of the Bureau of Surveys of Philadelphia, and have the upper corners of the stone parallel with the line, being beveled on each side so that the top is 10x4½ in. in size. The letters P and D are sunk on the bevel. The report indicates that the boundary is a source of inconvenience to the public and to individuals and should be adjusted to natural boundary lines.

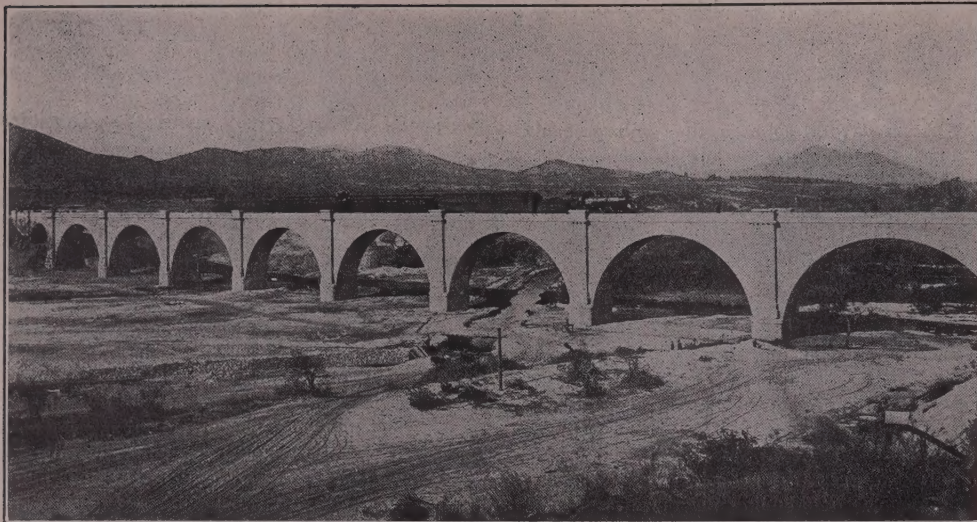
THE PRODUCTION OF ASPHALTUM and bituminous rock in the United States in 1904 amounted to 81,572 short tons, valued at \$903,741, a decline of nearly 28 per cent. from the production in 1903. The output of bituminous sandstone decreased from 38,633 short tons worth \$118,001 in 1903 to 19,641 short tons worth \$71,465 in 1904. The production of oil asphaltum decreased from 46,187 short tons worth \$522,164 in 1903 to 36,030 tons worth \$376,135 in 1904. The falling off in production is attributed by the U. S. Geological Sur-

vey to low prices due to severe competition. The imports from Trinidad decreased from 129,133 long tons worth \$367,003 in the year ending June 30, 1903, to 110,031 tons worth \$368,623 in 1904, while the imports from Venezuela in the same time increased from 16,445 tons worth \$74,874 to 50,194 tons worth \$217,017. The imports from other countries except Cuba also fell off.

THE MAINTENANCE OF WAY ORGANIZATION recently introduced on the Baltimore & Ohio R. R., with Mr. J. B. Dickson as its chief engineer, is under the general manager. There is a division engineer in charge of all maintenance-of-way matters on each superintendent's division, reporting direct to the superintendent; he, in turn, reporting to the general superintendent. The engineer of maintenance of way on each general superintendent's territory represents the general superintendent in maintenance-of-way affairs. He looks into all matters in the department and goes over the work on the different divisions and keeps in close touch with all matters pertaining to maintenance-of-way. He not only looks after the work on the road, but makes recommendations to the general superintendent on matters which come up for decision. The accounting for the entire maintenance-of-way department is done in the office of its chief engineer and all matters pertaining to work in the department pass through his office.

THE USE OF CONCRETE for sewers, in place of brick, seems to be assured in Boston for a reason that has nothing to do with the technical merits of the material. According to a prominent contractor of that city, the prevailing condition in the bricklayers' trade makes the price of sewer brickwork exorbitant. If a contractor has a long stretch of work on hand at a busy season of the year it is almost impossible at times to obtain enough bricklayers to carry on the work at the necessary rate. He is confronted with the fact that the engineers require first-class work while he is unable to secure mechanics competent to do it. The bricklayers' union prohibits the use of apprentices on sewer work. This is rapidly reducing the number of competent masons, and in a few years will raise the price of brickwork so much that but little of it will be used for sewers, in comparison with concrete.

THE BY-PRODUCT COKE OVEN is not making the progress in favor in the United States that it did in Germany for a reason that was pointed out very forcibly by Mr. W. H. Blauvelt recently. This is the lack of markets for the by-products. The crude coal tar is separated into pitch and oil. The market for pitch in this country has still to be developed. In Europe, where briquetted fuel is used extensively, enormous quantities of pitch are used in its manufacture, but there is no such use here, and the amount employed in paving, roofing and paint manufacture is insignificant in comparison with the total product. The oil is the source of anthracene, creosote, naphthalene, carbolic acid, benzol and the finer products made in the great German chemical works, but all these will require in their manufacture only a small part of the tar output of the country until they have been greatly extended. The ammonia products are important, but some of them, like the sulphate, will not find a market in the United States so good as that in Germany unless a great deal of expensive educational work is done. Illuminating gas is an important product of these ovens, provided it can be marketed, but the vital product is coke. Unfortunately the ability to make coke in the by-product ovens from grades of coal that could not be used in the bee-hive oven led to the production of inferior coke which gave the American industry a poor standing it did not deserve.



The Santa Ana Viaduct of the San Pedro, Los Angeles and Salt Lake R. R.

CONCRETE VIADUCT AT RIVERSIDE, CALIFORNIA

By H. Hawgood, M. Inst. C. E., Consulting Engineer, Los Angeles.

The most important structure on the San Pedro, Los Angeles & Salt Lake R. R., recently opened for public traffic, is the concrete viaduct over the Santa Ana River at Riverside. It consists of eight semi-circular arches of 86 ft. clear span, with an approach arch at either end of 38 ft. 6 in. clear span. The viaduct has a total length of 984 ft. and an average height of 55 ft. It was built from the designs of the writer, then chief engineer of the railroad, under the superintendence of Mr. C. A. Dodge. The work of construction commenced in December, 1902, and the first work-train crossed in January, 1904.

The structure is of Portland cement concrete throughout, without metal reinforcement. In designing the structure it was considered that the saving in material that might have been effected by the use of steel-concrete was not commensurate with the superiority of the heavier construction in absorbing the impact of heavy trains at high rates of speed.

The completed structure contains 12,544 cu. yd. of concrete, in the forming of which there was used 11,986 bbl. of cement. The total cost of the viaduct, including expenses of every kind chargeable to the structure, was \$185,307.33. At the contemporaneous price of steel bridging an alternative design of plate girders, with ballasted floors, on piers the same distance apart center to center, 100 ft., as used for the arched structure, would have cost at least 1 per cent. more than the concrete structure. In addition to its advantage in point of first cost, the concrete structure will be practically without cost for maintenance, and has the additional decided advantage that its stability cannot be affected by any possible increase in rolling loads. This is a very important point when it is considered that the replacement of steel bridging is more frequently brought about by increased rolling loads than by any physical deterioration of the steel itself.

Design.—In designing the bridge it was considered essential to satisfy the following requirements:

1. That considering the permanency of the material used and the difficulty that would attend any changes, the structure should have strength to meet any possible increase in the weights of rolling stock and loads.

2. That under the heaviest possible rolling load the maximum compressive stress on the concrete should not exceed 400 lb. per square inch.

3. That under all conditions of loading the line of resistance should lie within the middle third of the arch ring.

4. That there should be 3 ft. of good ballast under the ties to insure uniform distribution of the load and to absorb the impact of heavy trains moving at high rates of speed.

5. That all piers should be of the "abutment" type, so that if by accident any one arch were crippled the others would not be involved.

With a rolling load of 14,000 lb. per lineal foot, the maximum stress on the concrete would be 355 lb. per square inch. The heaviest locomotives in use at the present day do not concentrate more than 13,600 lb. per lineal foot of their driving base, and it is generally recognized that this close-

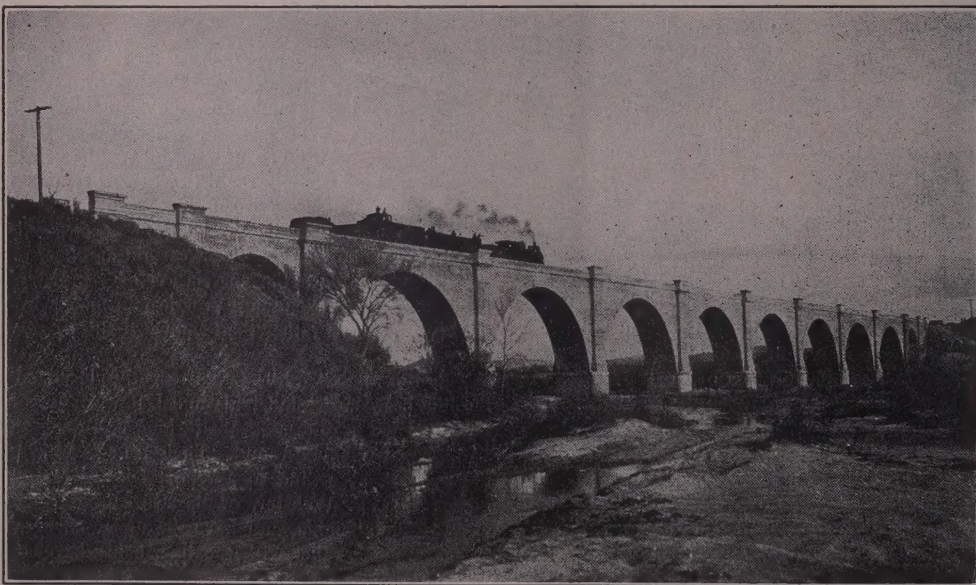
ture capable of carrying a rolling load exceeding 14,000 lb. on each and every foot of its length, together with the dead load of its own weight, will not be put out of service by any possible increase of train weights.

Incidentally, it may be said that the specifications for the steel bridging erected at other points of the S. P., L. A. & S. L. R. R. provide for a double-header, each with concentrated weight of 200,000 lb. on driving base of 15 ft., with total weight of 220,000 lb. on a 23-ft. base, coupled to tenders having 120,000 lb. on a wheel-base of 16 ft., making for both engines and tenders a weight of 680,000 lb. on a total base of 109 ft., followed by a train of 4,500 lb. per lineal foot. Under this loading the arches would be subjected to a maximum stress of 290 lb. per square inch.

The accompanying drawings show that the condition that the line of resistance must lie within the middle third is fulfilled throughout the entire range of possible loading.

The practical value of the adoption of abutment piers was brought out during construction, when, owing to difficulties in founding pier No. 7, arches Nos. 1 to 6, inclusive, were completed and their centering removed three months before pier No. 7 was ready for arches Nos. 7 and 8.

Foundations.—Soundings to determine the depth to bed-rock were made by sinking 7-in. well casing with a light portable well rig. The test holes were arranged in three parallel lines, the center one coinciding with the center line of the viaduct and the side lines 25 ft. right and left. The holes were arranged so as to occupy the four corners of squares laid diagonally to the axis of the viaduct and having a diagonal width of 50 ft. The information thus obtained was all that could be desired except in the case of the seventh pier. There the borings happened to strike massive boulders at a depth in harmony with other borings; subsequent developments proved actual bed-



The Santa Ana Viaduct of the San Pedro, Los Angeles & Salt Lake R. R.

ly approaches the maximum weight possible within the clearance dimensions as to height and width of existing railroad structures, beyond which any enlargement would cause the rebuilding of the entire railroad systems of the United States. With a weight on driving base of 13,600 lb. per lineal foot the weight distributed over the entire engine wheel base scarcely exceeds 11,000 lb. per lineal foot, and distributed over the total wheel base of engine and tender combined not over 8,000 lb. per lineal foot, while the train following will not weigh over 5,000 lb. per lineal foot. In view of these figures it is safe to say that a struc-

ture to be 12 ft. deeper. A prior knowledge of this fact would not have affected the location of the pier, but the method of foundation would have been modified.

The excavation of the shallower piers was conducted within cofferdams of a double thickness, breaking joint, of 3x10-in. Oregon pine sheet piling. The inside dimensions of the dams were 2 ft. greater in each direction than outside dimensions of footings. For the deeper piers triple sheet piling of 2 x 12-in. stuff was used, and the internal dimensions of the dams made 4 ft. greater in each direction than the footings.

The excavation was carried out principally by hand and partially by a 6-in. centrifugal dredging pump. The latter method was not attended by any degree of success in the shallower pits owing to insufficiency of water, and in the deeper pits, where water was more plentiful, the lift became too great for efficient work.

The two abutments and piers Nos. 1 to 6, inclusive, were founded on the granite bed-rock without any difficulty. Pier 7 was troublesome. The sheet piling at this pier, as at the others, was driven to refusal with a 3,500-lb. hammer and was thought to rest on bed-rock, more particularly so as the penetration agreed with the test-hole depths. The work of excavation, however, proved the sheeting had not reached bed-rock, that on the west side and north end in particular being entangled with boulders.

Before excavation had reached the bottom of

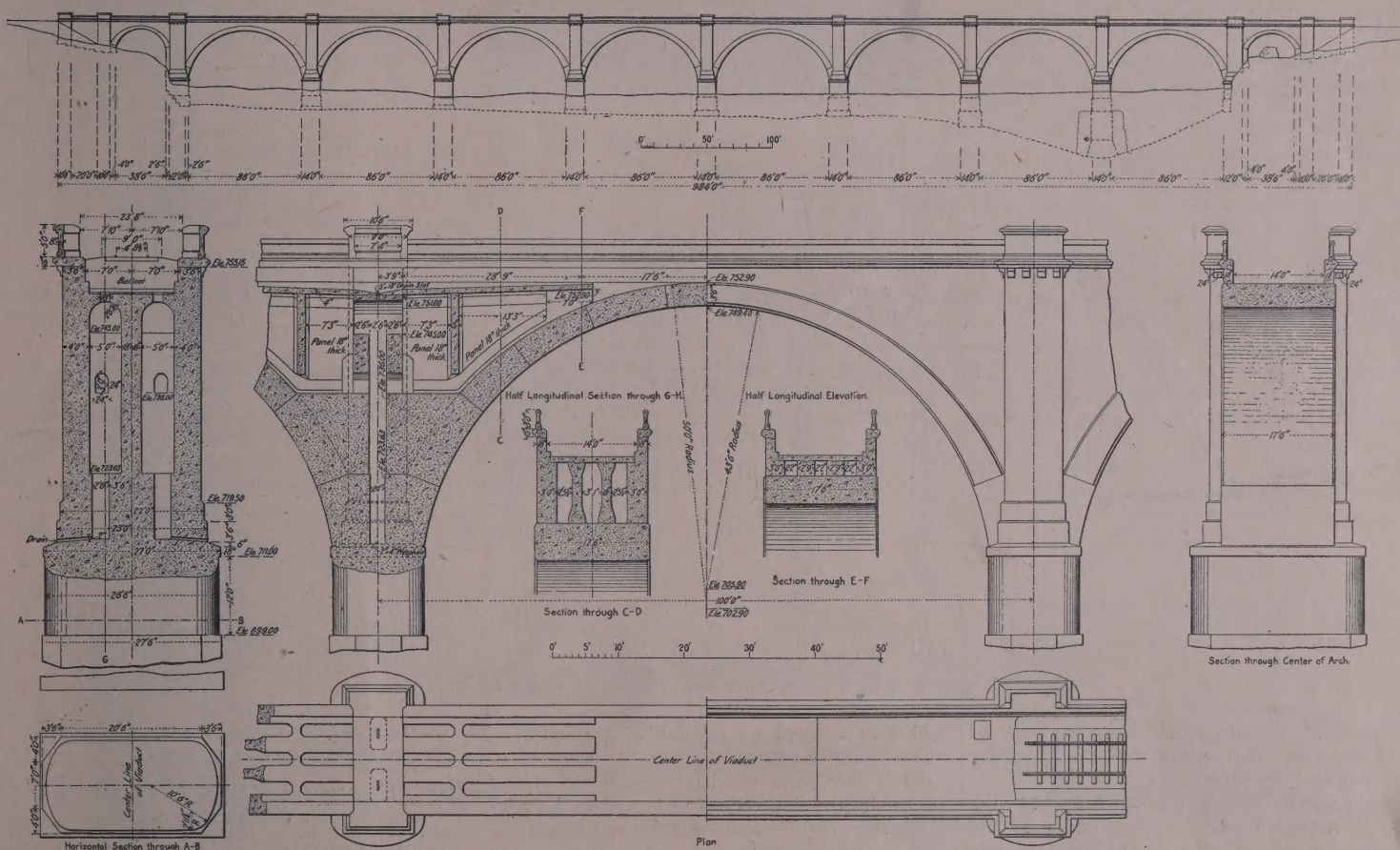
in each corner of the pit and one on the middle of each side to support the upper frames against further subsidence. The pumping machinery was then removed and the pit allowed to fill.

Grouting a Pier Pit.—Grouting was adopted with the object of both consolidating the material outside the lagging and reducing the inflow of water. In both these respects the results were gratifying, notwithstanding the full effects could not be realized on account of the straw and brush that had been thrown into the caved-in places to check the running sand. The grout was injected through a series of 2-in. pipes surrounding the pit at a distance of 5 ft. outside the sheet piling. The spacing of the pipes averaged 5.6 ft. center to center. Whenever a boulder was encountered the pipe was pulled and redriven until a spot was found where it could be driven to bed-rock.

The pipes were furnished with a loose cast-iron point that was left behind when the pipe was

angle of about 30 deg., provided with cross steps or riffles, after the manner of mining sluices, down which it was washed with a sufficient supply of water into a pyramidal hopper of about 10 cu. ft. capacity. The contents of the hopper were kept in continuous agitation by a 1-in. centrifugal pump drawing from the bottom and discharging back into the top of the hopper. The suction of the pump for injecting the grout also drew from the bottom of the hopper, and the discharge was fitted with a by-pass returning over the top.

From the time of first adding the water until final injection at the point intended, it was found to be absolutely essential to keep the grout in violent agitation to insure uniform consistency. Even a short stoppage produced separation into thin cream at top and paste at the bottom. At the completion of the working off of each batch clear water was turned liberally into the head of the chute and worked through the centrifugal and



Concrete Viaduct Over Santa Ana River at Riverside; San Pedro, Los Angeles & Salt Lake R. R.

the sheeting several runs of sand and gravel extending up to and causing depressions in the ground surface occurred on this side and end. These runs carried away the ground supporting the sheeting, which sank about 3 ft., dislocating the frames and narrowing the pit. These runs were traceable in the main to shortage of pump capacity. Much water was encountered, to meet which the available pumps were run to their utmost capacity. With every stoppage to re-lace a belt or for other repairs the pit quickly flooded. The repeated flooding and emptying thus occasioned without doubt did much to disturb and bring down the unstable material lying outside the sheeting.

Excavation was continued below the sheet piling by the customary method of square sets and driving short lagging. Progress was unsatisfactory, and, by reason of the condition of the sheeting above, became hazardous, and excavation was discontinued. Preparations were made for injecting cement grout into the material outside the sheeting by first driving a 14-in. pile to bed-rock

raised, leaving the full bore free for discharge of grout. The pipes were driven by an annular hammer weighing 600 lb., the center hole being large enough to clear the pipe couplings. The blow of the hammer was taken by wrought-iron clamps, bolt-tightened onto the pipes. Two pairs of clamps, one resting on the other, were generally required to take the blow without slip. The maximum drop of the hammer was 10 ft. It was operated by two men with blocks and tackle. The raising of the pipes was done by Barrett track jacks applied to the under side of the same clamps. The total length of pipe driven and raised was 966 ft. The average drive per day was 57 ft., and the average raise and grouting 34 ft. The driving gang consisted of four men, and the grouting gang of seven men, disposed in the following manner: Two men mixing grout, one man attending pumps, four men raising pipes and handling grout hose.

The grout was mixed as required in batches of any desired quantity. The cement was cast into the head of an inclined chute, standing at an

injection pumps and pipe system in order that any sedimentation might be washed out before it could set and clog the passages.

Various brands of cement were used in making grout, and it was noted that from one and all there was a precipitate, varying in quantity in the different cements, of fine particles, dark colored, heavy and sharp, entirely void of cementing properties. This is suggestive of an additional method of testing and comparing cements besides those in ordinary vogue.

Injection was done by an ordinary $4\frac{1}{2} \times 3\frac{3}{4} \times 4$ -in. duplex steam pump of the outside packed plunger type, rubber valves and movable brass valve seats. Hard cast-iron seats would have withstood the wear better and have been preferable. The discharge pipe-line from the pump was fitted with Moran ball joints to give flexibility, and terminated in a three-way cock, from which rubber hose led to connections at the top of the grouting pipes. This arrangement allowed two grouting pipes to be in service at one time, and by switching from one to the other as needed the

The arch rings were of Gillingham Portland cement in proportion of 1 of cement to 2 of sand and $4\frac{1}{2}$ of crushed limestone, crusher-run passing $2\frac{1}{2}$ -in. mesh. This mixture gave 1.032 bbl. cement to the cubic yard of finished concrete, samples of which, out of the work, weighed when one year old and very dry 152 lb. per cubic foot, with a porosity of 7.8 per cent., showing that a concrete of great density had been obtained. Colton limestone was used, the same as used at Colton in the manufacture of the cement.

The cost of forms per cubic yard of concrete was a large item. The use of concrete building blocks for the outside faces bonding into the mass concrete behind, thus eliminating much of the wooden form work, could probably be made to reduce the cost of such structures.

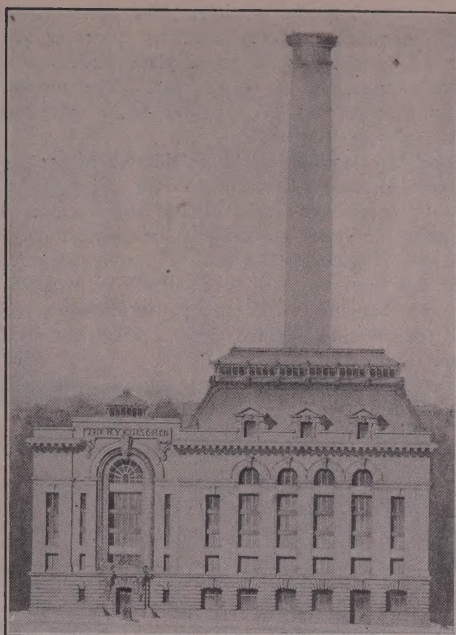
The greater part of the concrete was mixed by machinery, only a small percentage being hand-mixed. The mixing plant consisted of three rotary mixers, fed through measuring boxes from elevated bins containing the gravel, crushed rock and cement. The mixers discharged into dump cars operated by cable on a track carried above the arches at the level of the coping. From the cars the concrete was discharged through movable chutes to the place desired.

Machine mixing cost for labor 35.56 cents; fuel, 8.27 cents; total, 43.83 cents per cubic yard, exclusive of machinery expenses.

Hand mixing cost 62.63 cents per cubic yard. Transporting by cable and track cost for labor 3.28 cents; fuel, 4.09 cents per cubic yard; total, 7.37 cents per cubic yard. The average haul was 500 ft.

Setting Forms for Concrete.

Care in setting forms for concrete will make a considerable difference in the cost of concrete sewer work, according to Mr. H. P. Eddy. In one case under his observation the concrete meas-



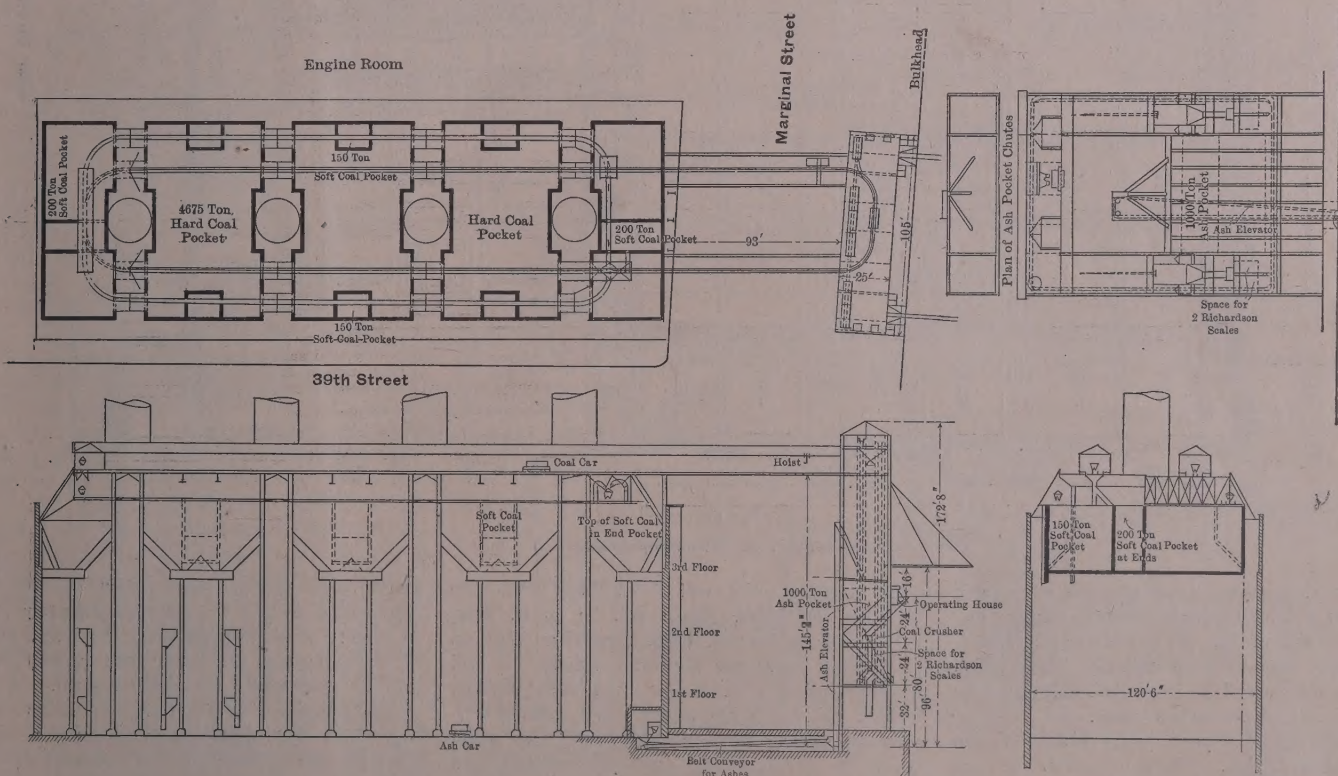
The New Waterside Station of the New York Edison Co.

On the completion, late in 1901, of the original Waterside station of the New York Edison Co., with an initial generating capacity of over 32,000 kw., it was thought that it would be able to provide, when completed to its contemplated total capacity of over 64,000 kw., ample power for many years. Scarcely three years later, although the station was completed to nearly this capacity, it was evident that within another year it would be inadequate for the probable demand for current. Accordingly a second large plant, known as "Waterside Station No. 2," has been designed

sizes of 300 hp. or less, but large units were brought out so rapidly that in place of the last five engine units in the first station as originally planned four 5,000-kw. Curtis turbine units were installed. All the units of the new plant will be steam turbine driven.

Location.—An important question connected with the design of the new station was its location. While the original Waterside plant had been located considerably to the north of the actual center of consumption of current among the sub-stations at the time of its installation, still the trend of the growth of the service has shown with increasing force the wisdom of this selection. There was nothing to be gained in the selection for the new station of a site far removed from that of the old Waterside plant, while an adjacent location would permit easy interconnection, both on the electrical and steam ends. While Waterside No. 1 and Waterside No. 2 will be provided with tie connections both in the electrical and steam equipment, independent feeders from each will supply the several annex stations over different subway routes, thus providing the advantages of two independent sources of current supply with the economies of joint operation. Moreover, the two plants could be superintended by a single organization when separated only by an intervening street.

For the new station the entire city block immediately to the north of that occupied by the original plant was secured, thus providing for the new plant facilities for receiving its coal by barges and an ample condensing water, equal to those enjoyed by the other. The block occupied is bounded on the West by First Ave., on the sides by 39th and 40th Sts., and to the East by the East River. The new plant will occupy the entire length of the block, 338-ft., whereas the original station occupies only 272-ft. 6-in. of its plot. The space of 125-ft. adjacent to the river's edge will not be built upon, as it may



Details of the Coal Handling Plant and Storage of the New Waterside Station.

ured in the batch was 120 per cent. of the amount which the section actually called for. The foreman was taken to task and on the next two sections of the work the amount used was 87 per cent. of what the plans called for, a variation due to the shifting of the forms only 2 or 3 in.

and is now under construction. The new plant, while following in general the lines of the older station, is an evidence of the evolution in power plant practice following the introduction of the steam turbine. When the original station was designed, the turbine was undeveloped except in

eventually be reclaimed by the city for use as a river front street; but upon it will be located the coal and ash-handling tower and equipment. This location provides excellent foundation facilities for heavy machinery, solid mica schist underlying the entire area. The rock surface slopes

toward the river, so that while at the First Ave. end rock had to be excavated to receive the column footings, toward the river, piers from 10 ft. to 30 ft. high were necessary. For the circulation water inlet and discharge tunnels a trench approximately 35 ft. wide by 30 ft. deep had to be excavated.

The boiler room section consists of a 20-ft. basement, two 33-ft. stories for the boilers and above this a space of 50 ft. for the coal storage bunkers; the distributing tracks of the coal handling system will be in the roof monitors. The turbine section has a 25-ft. basement for condenser apparatus and a main turbine room with a clear height of 88 ft. On the 40th St. side are six mezzanine galleries above the main floor for

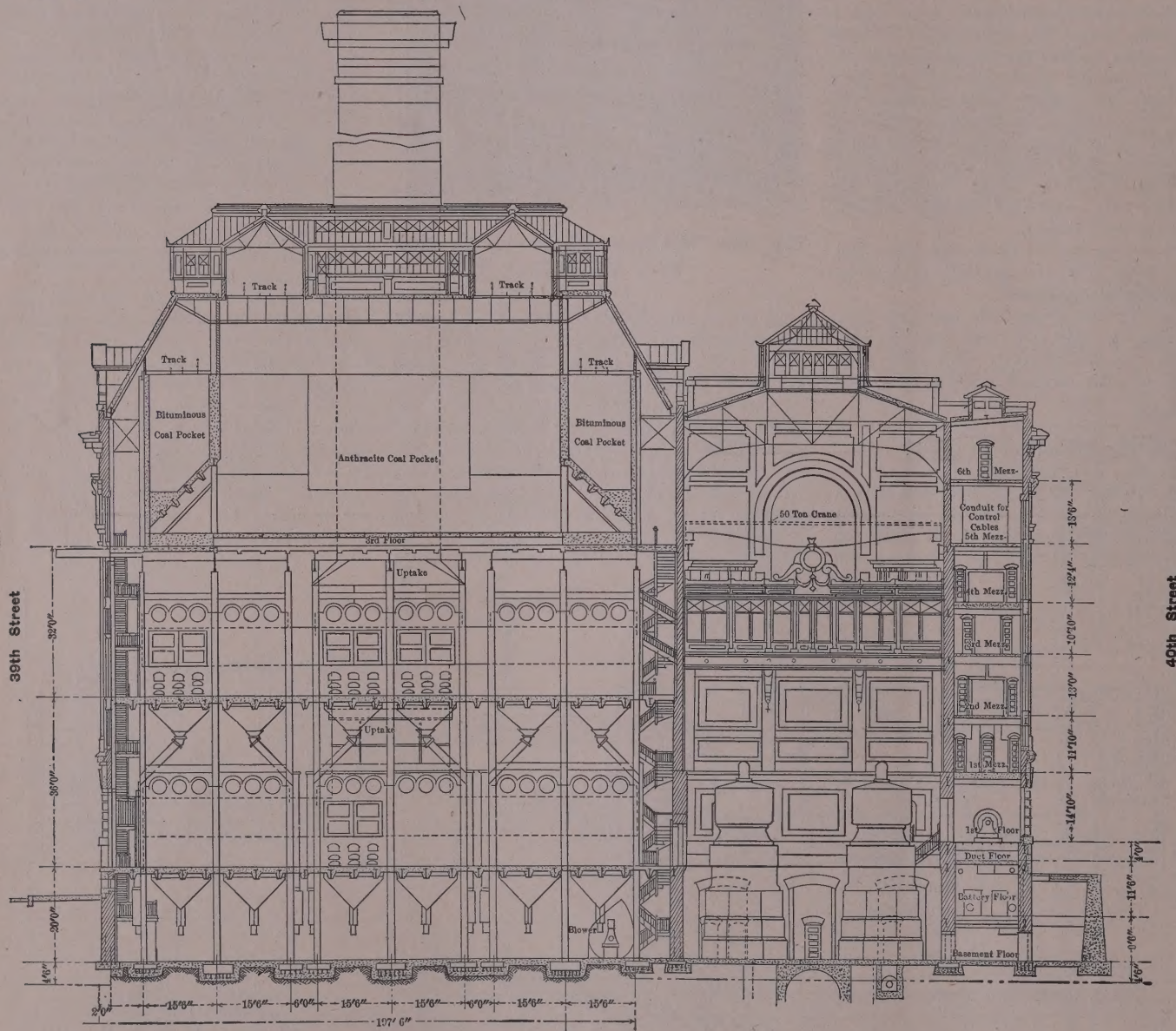
ft. span and 20 ft. monitor. The boiler room roof, monitors and coal handling apparatus are carried by a series of 72-in. plate girders and 15-ft. trusses, all of 90 ft. span. The turbine room is traversed by a 50-ton Shaw traveling crane of 52½-ft. span.

The new station has been laid out to accommodate ultimately ten turbine units of 7,500 or 8,000-kw. capacity, each, giving a total station capacity of over 100,000-h.-p. or, with the 50 per cent. overload rating, of over 150,000 h.-p. At first, however, only four turbines will be installed, two of these of the Westinghouse-Parsons type and the other two of the General Electric Curtis type.

Turbine Units.—The new 7,500-kw. Westing-

turbine generators. They are wound for either 6,600 or 11,000 volts. As connected they will deliver three-phase current at 6,600 volts and frequency of 25 cycles per second. Their efficiency will approximate 97.5 per cent. at full rated load, and they will be able to sustain 50 per cent. overload for three hours without dangerous rise of temperature of windings.

The two Curtis turbo-generators to be supplied by the General Electric Co. will have nominal ratings of 8,000-kw. with 50 per cent. overload capacity for 2 hours. Except for the increase in size, these turbines will closely resemble the 5,000-kw. Curtis turbines now in operation in the original Waterside station. Their diameter at the base will be slightly over 15 ft., while the



Cross-Section of Waterside Station No. 2.

the electrical switching equipment and a basement gallery for a sub-station and reserve exciter storage-battery equipment. As in the original Waterside station, the operating galleries, from which the entire station will be controlled, will be at the First Ave. end of the turbine room.

The building is of steel frame and brick and concrete construction. The boiler room and turbine room floors are of the Roebbling system and designed for uniform loadings up to 600 lbs. per square foot. The structure carries on the boiler room side, five anthracite coal bins holding a total of 20,000 tons when filled. The bins are of reinforced concrete construction with vertical stiffeners of I-beams embedded at intervals. The roof trusses above the turbine room have 57½

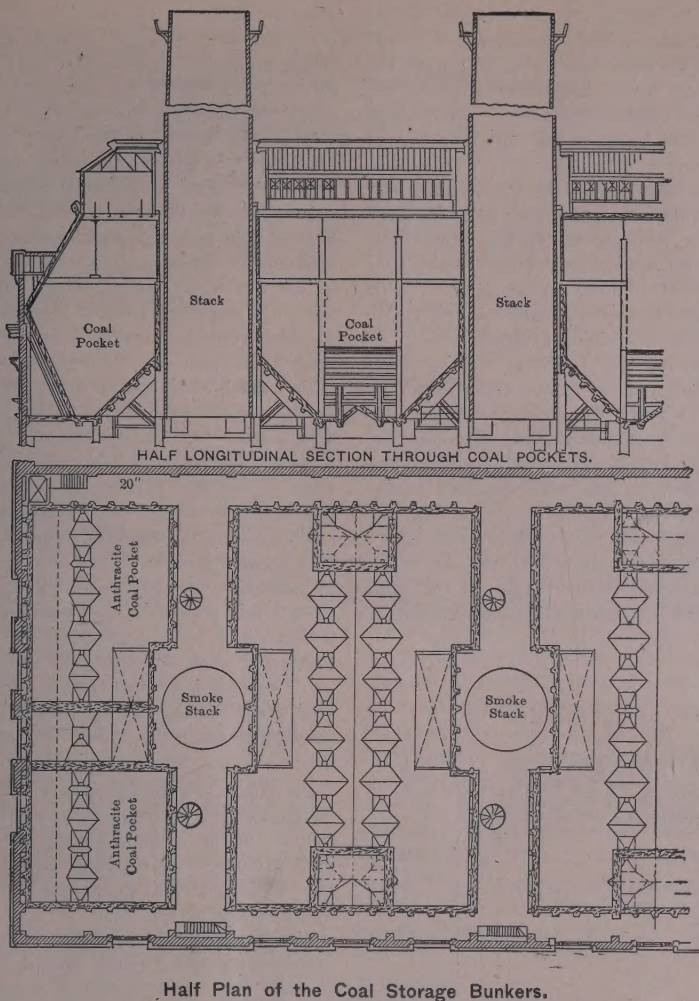
house turbine units will differ little from the 5,000-kw. machines. Each will be 50 ft. long, 17 ft. wide and 15 ft. high, occupying 0.113 sq. ft. of floor space per kilowatt capacity. It will be only about 4 ft. longer than the 5,000-kw. turbine unit, while the width will remain practically the same. These turbines will take steam at 175 lb. pressure and 100° of superheat, and the speed will be 750 r.p.m. normally. Under the above conditions and a vacuum of 28 in., the steam consumption at full load will be approximately 16 lb. per kilowatt hour.

The generators connected to the Parsons turbines will be of the standard Westinghouse design, except for a new enclosed construction to eliminate the humming noise peculiar to high-speed

height over the governor dome will be 32 ft. Their total weight will be approximately 700,000 lb. each. In accordance with the latest practice of this company, the water type of step bearing will be used under the vertical shaft.

The generators of the Curtis units have a rating which will permit them to carry a load of 9,000-kw. for 24 hours, or an overload of 50 per cent. for two hours. The generators are of the four-pole type, and operating at the normal speed of 750 r.p.m. will deliver three-phase current at 6,600 volts and a frequency of 25 cycles per second.

Boilers.—The boiler arrangement adopted is upon the cross-fire room plan, which has become typical of the more recent large turbine stations.



in this country. In the majority of cases, however, it has been found preferable to concentrate the firing rooms as much as possible, with the result of a less convenient arrangement of stacks, whereas in this plant a division of fire rooms was selected which, as may be noted in the accompanying plan, is more advantageous for the flue, stack and coal bunker arrangements. On each boiler floor there are three main firing rooms each having a row of six boilers in three batteries on either side, and at either end of the building a half firing room with a single row of six boilers; this arrangement permits the use of only four stacks, which will be symmetrical in design, each stack serving twelve boilers on each floor. The objection to half firing rooms that might be offered to this arrangement for a smaller plant will here not prove serious as, owing to the magnitude of the station, it will be an easy matter to divide the work between boilers at all times to the best advantage for the firemen.

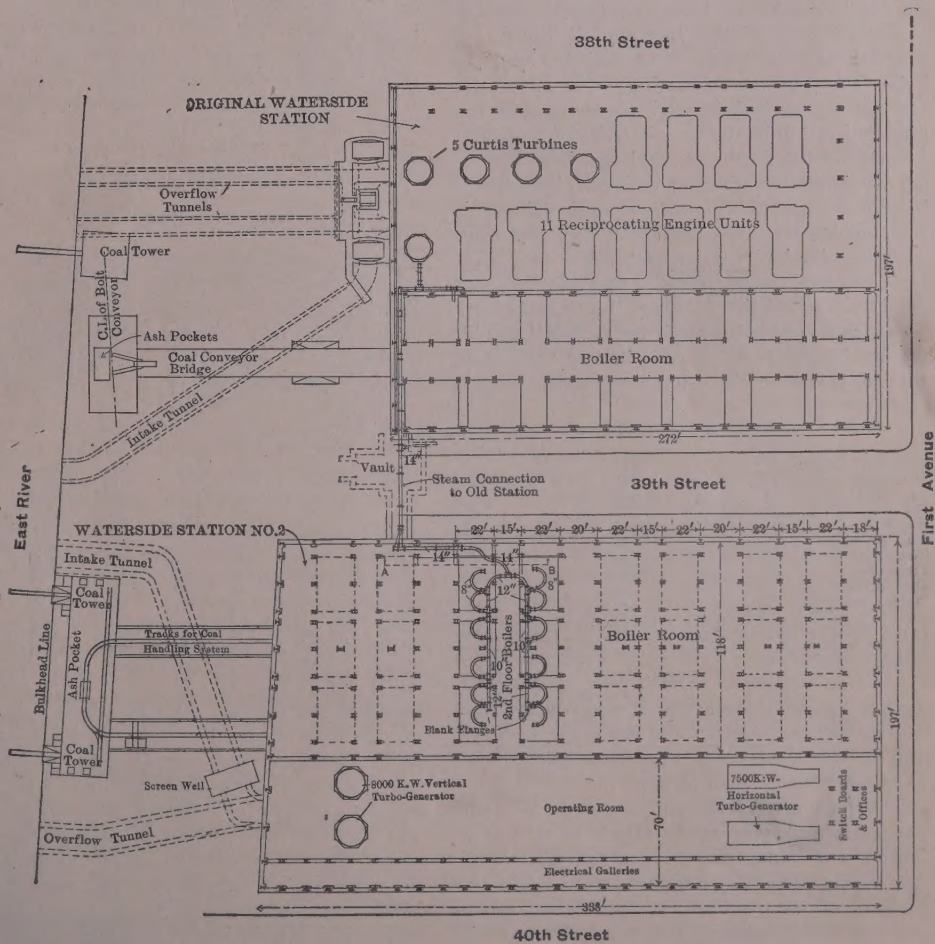
The boilers selected for the new station will be of the Babcock & Wilcox water-tube type, equipped with the new Babcock & Wilcox superheaters. Space is provided for 48 boilers on each boiler floor, or 96 in all. Each boiler unit will be of 650-h.-p., designed to deliver steam at 200 lb. pressure and a superheat of from 100° to 150°. Each boiler consists of three 42-in. steam drums and has 294 4-in. tubes 18 ft. long, arranged 21 tubes wide and 14 tubes high, thus presenting a total heating surface of about 6,500 sq. ft. The vertical rows of 14 tubes each deliver into a continuous wrought-steel header of a new design, which materially simplifies the construction. The boilers will all be fitted with flat grates for hand firing.

Both natural and forced draft will be provided, the latter permitting an advantageous flexibility in the burning of low grades of fuel. For the forced draft supply there will be installed

two Sirocco blowers of 90,000 cu. ft. capacity per minute for each row of six boilers. These fans, which will be fitted with cases and driving engines by the B. F. Sturtevant Co., Boston, are to be located on elevated platforms at the sides of the boiler room, from which position the delivery will be through ducts leading down to cross flues beneath the ash pockets. Damper openings are to be provided at each opening so that the blast may be regulated at will. Sufficient capacity is provided in each blower to operate the entire six boilers to their maximum if at any time this is found necessary.

Chimneys.—The products of combustion are discharged through four large self-supporting steel stacks rising 300 ft. above the first floor level of the boiler room. Each stack will serve 24 boilers, consisting of one-quarter of the equipment. Connection is made, as shown in the cuts, to each stack through a flue and uptake, which rises in the space between the rear ends of the double row of boilers up into the base of the stack. This flue is built of $\frac{3}{8}$ -in. plate and $2\frac{1}{2} \times 2\frac{1}{2} \times 5/16$ -in. angles, having openings 3 ft. 9 in. x 9 ft. in area, at the rear of each of the 24 boilers served. In the main uptake from the first to the second floors, which is $8\frac{1}{2} \times 24$ ft. in section, there is a baffle plate to prevent interference of draft when one side is idle. At the second boiler floor level the flue opens out to an area of $12\frac{1}{2} \times 31$ ft., changing section above that to 21 ft. square at the opening beneath the stack. The entire flue and uptake structure will be enclosed in a non-conducting covering.

The stack which thus commences at the third story level is 232 ft. high, and has an inside opening varying from $21\frac{1}{2}$ ft. at the base to 20 ft. at the top. It consists of 31 courses of plate varying in thickness from $\frac{3}{4}$ -in. at the base to $\frac{3}{8}$ -in. at the top. It is lined with 4-in. hard, common red brick, backed up to the shell with 1 in. of concrete. This lining will be supported by



General Plan of the Old and New Power Stations.

an angle framework throughout the interior of the stack with horizontal members at every third plate of the shell; this permits any section to be renewed without disturbing the remainder.

While there is no intention of installing economizers at the present, it will be noticed that with the arrangement of uptake and flue adopted, there is ample space provided for them toward the sides of the boiler room. Additional connections for such a purpose could easily be made from the boiler setting to the economizer, from which the outlet connection could be joined to the uptake with ease. The middle boilers of each group are inaccessible for such a connection, owing to presence of the main uptake at their rears.

Piping.—From the header at the turbine room division wall a branch steam pipe extends up and over the rear of six boilers, looping back from this point over the rear of the other six and down to the header again. The loop is equipped with intercepting gate valves between each battery, which thus has two distinct outlets to the main header. The loop header or branch is located about 5 ft. above the boiler settings, and connections to it from the boilers are made by heavy return bends of 8-in. pipe of 5 ft. 7 in. radii. Each bend has two valves, that next to the boiler a plain gate valve and the other is a non-return stop valve.

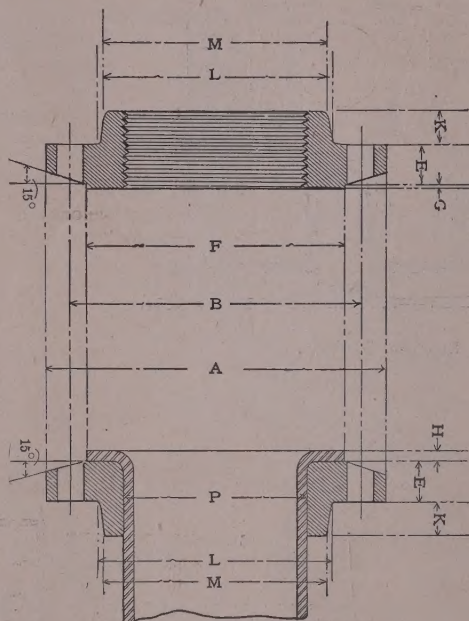
The main steam header will be of 14-in. pipe, and is to be located in the areaway alongside the division wall on the first floor, where the branch loop connections may easily be made to the boilers upon either floor. The branches to the turbines will be carried from the header through the basement, so that no piping will be visible in the turbine room, although the control of valves will be readily accessible at the machines. All of the high-pressure piping will be of wrought steel with Van Stone joints using sheet steel gaskets. The flanges used for these joints will be of rolled steel and of a special design with beveled or recessed edges, permitting easy inspection of the joint at all times. A new schedule of flange sizes will be used, as indicated in the accompanying table.

A novel feature of the feed-water piping for the new station will be the use of steel pipe with Van Stone joints on the mains and larger branches using 5 and 6-in. pipe, the 3-in. individual branches to each of the boilers being also of steel. The feed-water piping system consists of a 6-in. ring main encircling the boiler room, with 6-in. cross headers connected across from the two sides in front of each row of boilers. From the cross headers a branch is carried to each boiler, consisting of a 5-in. branch between each battery connecting through a tee to the 3-in. brass boiler connec-

discharge pipe to the condenser overflow tunnel beneath the turbine room. The piping is all of wrought iron with screw-flange joints, except the branches leading from the boiler mud-drums, which are of extra heavy brass pipe. Each blow-off connection will be provided with two valves for protection from leakage.

Condensing System.—For the condensing system a novel arrangement of intake and discharge tunnels has been incorporated in the foundations to bring the circulation supply direct to the condenser pumps. The intake tunnel is 12 ft. wide and nearly square in section, while on either side of it are two smaller tunnels, about 6 x 12 ft. in section each, for the overflow, and both extend longitudinally under the turbine room so as to reach every unit. Connections for the condenser apparatus are made through openings arranged in the basement floor. The condensing apparatus has not as yet been selected either as to type or make, as is also the case with the boiler feed pumps and feed water heaters.

Coal and Ash Handling.—Coal will be delivered to the new station by barges in the East River, which will be unloaded by a tower similar



New Pipe Flange Details.

to that of the old station. From the tower cars running on an elevated cable railway will distribute the coal to the pockets over the boiler room. The tower will be a steel structure, 105 ft. long, 25 ft. wide and 172 ft. high, containing the barge unloading apparatus, coal receiving bins,

tons per hour. The cable railway makes a complete circuit of the coal pockets above the boiler room, embracing 835 ft. of track; the cars when in operation will be spaced 133 ft. apart and will travel 265 ft. per minute.

The coal pockets in the boiler house consist of five large bins which hold in aggregate over 18,000 tons. The large bins are intended for anthracite only, while for other classes of fuel eight smaller bins of 150 and 200 tons capacity are incorporated within the large ones so as to deliver to each of the five firing aisles. The large bins are designed to discharge without pocketing to all points of their respective firing aisles, while the small individual bins will deliver at the ends, from which the bituminous or other fuel will have to be distributed in barrows. The small bins will undoubtedly be used for bituminous coal, which is sometimes used with the anthracite in proportions of one part to five parts of anthracite, during intervals of the very heavy peak overloads.

The ashes from the boiler furnaces will be handled from the boiler house basement by a system of small cars operating upon narrow-gauge tracks to the ash pocket in the coal tower. This ash pocket is of large proportions, holding 1,000 tons, and is elevated so that the outlet spout is 32 ft. above high tide level. Ashes are delivered from the cars to the pocket by an elevating conveyor, and outlet spouts are provided for delivery either to wagons or boats.

Electrical Features.—The electrical control equipment for the new plant will be very similar to that in the original station, the only features of departure being in minor detail where practice has indicated the possibility of improvement. While much of the detail of the other electrical equipment is not as yet decided, there are several interesting features which may be mentioned now. Among them is the exciter system, which will consist of four 150-kw. motor-generators, delivering direct current at from 200 to 280 volts, supplemented by a storage battery; the storage battery will float upon the system constantly, but not so much in the sense of reserve capacity as in security from interruptions, which it is arranged to prevent absolutely.

Service Furnished.—In this connection data as to the remarkable growth of the Edison lighting system in New York City will be of interest. In the winter of 1901-02 the maximum output of the station was 35,000 kw., which occurred at about 5 p. m., December 23. During the past winter the maximum was 54,500 kw., on the substation direct-current bus bars, which occurred at about 5 p. m. on December 22, 1904. This represents an increase in maximum peak load of 19,500 kw. in the past three years, and from present indications of the company's output, the maximum peak load for next December will go up to 60,000 or 62,000 kw. There are, in all, at present nineteen sub-stations from which the low-tension service is distributed, and of these three were installed new within the past year or so. Nearly all the others have been enlarged lately, so that the distribution equipment has experienced as radical a change as that under way at the generating station.

The installation connected to the company's mains on Aug. 1, 1905, was as follows: Incandescent lamps, 16 candle-power equivalent, 1,651,917; arc lamps, 22,093; storage batteries and heating appliances, 2,539 kw.; horse power in motors, 99,258; total installation, 16 candle-power equivalent, 3,425,106.

The offices of the New York Edison Co. and the construction and operating staffs are as follows: President, Anthony N. Brady; Vice-President and Treasurer, Nicholas F. Brady; Second Vice-President and General Manager, Thos. E. Murray; Third Vice-President and Associate General Manager, J. W. Lieb, Jr.; Secretary,

STANDARD PIPE FLANGES—NEW YORK EDISON CO.

Nominal diameter	2½	3	3½	4	4½	5	6	8	10	12	14
Dia. flange, A	7½	8¾	10	11	12½	15	17½	20	22½	25	27½
Dia. B, C, B	5½	6¾	8	9	10½	12½	15	17½	20	22½	25
No. holes	6	8	8	8	8	8	12	12	16	16	16
Size holes, D	7½	8¾	10	11	12½	15	17½	20	22½	25	27½
Size bolts, d	¾	¾	¾	¾	¾	¾	1	1	1½	1½	1½
Thickness flange, E	1	1½	1¾	1¾	1¾	1¾	2	2	2½	2½	2½
Dia. seat, F	4½	5½	6	7	8	9	10½	12½	15	17½	20
Height seat, G	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾
Height seat, H	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾
Length hub, K	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾
Large dia. hub, L	4½	5½	6	7	8	9	10½	12½	15	17½	20
Small dia. hub, M	3½	4½	5	6	7	8	9	10½	12½	15	17½
Outside dia. pipe, P	3	4	5	6	7	8	9	10½	12½	15	17½

tions. The feed pumps for the new plant have not as yet been selected and the initial feed system for the first group of boilers will be supplied from the original station.

The blow-off piping will consist of a single header of 4-in. pipe at the rear of each row of boilers, into which every boiler delivers through two 2½-in. brass blow-off connections. The two headers at the rear of boilers in every chimney flue space discharge downward through 6-in. connections to a tee leading to a common 8-in.

crushers, etc., together with an ash handling and storage equipment. The unloader hoist jibs, of which there are two, one at either end of the tower, are to be 96 ft. above high tide level, from which the lift to the receiving bins will be 80 ft. The receiving bins deliver to coal crushers and thence the coal is elevated 125 ft. to the top of the tower for delivery to the cable cars. Of the latter there are to be seven of 3 tons capacity each, which will be loaded at a rate of about two per minute, giving thus a total capacity of 357

Lewis B. Gawtry; Auditor, H. M. Edwards; Assistant Treasurer, Jos. Williams; Controller, C. S. Shepard; General Inspector, Arthur Williams; Chief Engineer, James D. Andrew; Chief Electrical Engineer, Philip Torchio; Acting Civil Engineer, E. M. Van Norden; Superintendent of Construction, J. P. Sparrow; Superintendent of Distribution, Henry Stephenson; Chief Draughtsman, George A. Orrok.

The Classification and Peculiarities of Steam Turbines.

Although the information lately published concerning steam turbines is voluminous, it is difficult to find any unbiased general statements concerning all types of such machines. One reason for this is the fact that few people agree even on such a general subject as the classification of steam turbines, and in view of the different views on this topic it is only natural that equally diverse opinions should be held concerning details. Prof. Storm Bull recently read a paper before the Western Society of Engineers in which the classification and peculiarities of turbines were discussed at some length, and this paper deserves attention because the author advocates the adoption of certain German views concerning classification which are more rational than those customarily held in the United States.

The first steam turbine, the 10-h.-p. wheel built by C. A. Parsons in 1884 was a reaction machine, while the next type, the de Laval wheel of 1889, was an impulse wheel, using the terms commonly employed. The early machines were at the extremes of turbine possibilities and development has taken place along the whole line of types between them, which should be classified, Prof. Bull says, according to the manner in which the steam acts rather than by their external appearance or speed. The only essential difference between water and steam turbines is that in one the fluid is incompressible while in the other it is compressible. Unfortunately, turbine water wheels are all really reaction wheels, although where all the energy of the water is developed as a jet the wheels are commonly called impulse wheels. This rather unfortunate use of terms has led to the introduction in Germany of new names for these classes, velocity and pressure turbines, which Prof. Bull advocates for general adoption. In a velocity-turbine, like the de Laval, the steam expands exclusively in passing through the guide wheel or nozzle, and no expansion takes place in the turbine wheel proper, so the pressure is exactly the same on entering the turbine wheel as on leaving it. This is only possible if the guide and turbine wheels are in separate chambers. In the pressure type, like the Parsons turbine, the pressure gradually decreases from one end of the machine to the other, and the steam expands in the turbine wheels. The classification of steam turbines is not so simple as that of water turbines for another reason, the practicability when using steam of introducing multistage operation, a subject Prof. Bull discusses at some length.

With steam of even fairly moderate pressure, the velocity of efflux into vacuum, is several thousand feet per second. According to both theoretical and practical hydraulics, the velocity of rotation of the moving blades or buckets, should be not far from one-half of that of the steam, in order to get the best efficiency. For steam of 150 lb. pressure by the gauge and a vacuum of 27 in., the velocity of the steam is not far from 4,000 ft. per second; consequently, the velocity of rotation should be nearly 2,000 ft. per second. De Laval lets his smaller size turbines run with 30,000 r.p.m., and in that manner obtains a velocity of rotation which is not too far away from what it ought to be. For turbines of greater power,

the maximum capacity being 300 h.-p., he found it necessary to use a larger wheel, and the limit of the size is determined by the number of revolutions and the strength of the material of which it is made. With these larger sizes the number of revolutions had to be cut down to some 15,000, even though they are made of the very strongest nickel steel, and the velocity of rotation is only about two-thirds of what it ought to be for the very highest efficiency of the turbine. It has been found impossible to go higher than 300 h.-p., notwithstanding the most careful study of the problem, and de Laval had to invent the flexible and self-adjusting shaft before his turbine could become a practical success.

The purpose of the many stage or multiple steam turbine, is to get around this difficulty, with respect to the high velocity of efflux of steam. Instead of changing the energy of the steam all at once into kinetic energy in a nozzle like that of de Laval, this may be done in several steps, the energy corresponding to each step being utilized or absorbed by the wheel before the next step is reached. If, for instance, there are 50 steps—as in many of the Parsons turbines—and the difference between the pressure in the boiler and condenser be 150 lb., then the average drop for each step is only 3 lb., and the corresponding velocity of the steam comparatively small. However, the impression must not be left that in a many stage turbine the pressure drop is constant for all the wheels. It may be so, but ordinarily it is only approximately so, and it is not essential to a high efficiency. By this method, then, it is possible to have a very much smaller velocity of the steam, and consequently an equally smaller velocity of rotation, so that the troublesome problem of finding a material which could withstand the centrifugal force generated by the high rotation speed has been gotten rid of.

Returning to the classification of steam turbines, the question is whether these many stage turbines are pressure or velocity turbines. The answer is that there are many of both kinds. In a many stage velocity turbine, the pressure in the small clearance between the guide wheel and the turbine wheel should be the same as between this latter and the next following guide wheel, and the drop of pressure takes place in the guide wheel. Practically there will be a very small drop of pressure in the turbine wheel, just sufficient to overcome the frictional resistance which the steam has to overcome in passing through the wheel, even though, as is now well established, the drop of pressure does not represent a total loss to the turbine; the real loss being only the lowering of the energy from the pressure on entering the guide wheel, to that in the turbine wheel. The best known velocity turbine in the United States is Curtis', in which the steam flows from a series of nozzles into the first turbine wheel, from which it flows through a guide wheel into a second turbine wheel, the pressure remaining nearly constant from the entrance to the first until the exit from the second turbine wheel. From this latter the steam collects in a small reservoir, and is then expanded through nozzles and flows through a turbine wheel, again through a guide wheel, to a second turbine wheel and into a second reservoir, and so forth. In this manner there may be three or four pressure stages, each one subdivided in two velocity stages, this latter subdivision serving also to reduce the velocity of rotation.

The Rateau turbine belongs also to the velocity class of turbines. In this there are as many pressure stages as there are turbine wheels, and the space between each turbine wheel and the next following guide wheel, forms a reservoir from which the steam flows into the guide wheel in passing, which the steam expands and changes part of its heat into kinetic energy. That this tur-

bine must be a velocity turbine seems evident from the fact that the guide wheels are not provided with openings all the way around; the turbines being what are called "partial wheels." As the steam expands, after passing through successive wheels, the number of the openings or buckets in the guide wheels, increases until it becomes necessary to either widen these openings radially, or to enlarge the wheels themselves. The important point here is that the expansion of the steam takes place in the guide wheels, except so far as it is necessary to overcome the resistance in the turbine wheels; hence the Rateau turbine is a velocity turbine, but of many pressure stages.

In many stage pressure turbines, the pressure is gradually reduced from the moment the steam enters the first guide wheel until it enters the condenser. The expansion of the steam takes place both in the guide and turbine wheels, the velocity of the steam also increasing, and more rapidly, toward the end than to begin with. The most prominent example of the class of steam turbines is that of Parsons. Depending on the pressure of the steam and of the power of the turbine, the number of wheels in a Parsons turbine may be as large as 80, although about 60 probably is more nearly the average. It is of course quite possible to build a Parsons turbine with a very much smaller number of wheels, and evidently such a turbine would be very much cheaper to build. The drop of pressure would then be correspondingly greater for each wheel, also the velocity of the steam as well as that of rotation, and consequently the number of revolutions. If, therefore, it be desired to design a wheel with a comparable low number of revolutions, it is necessary to use a large number of wheels, and presumably this consideration has been the leading one at least in the choice of the number of wheels in the Parsons wheel as it is built. Questions of the strength of materials necessarily also enter the problem, and to a certain extent also the efficiency of the turbine. With a high velocity of the steam, the friction per running foot necessarily must be greater than for a low velocity, as it is supposed to vary with the square of the velocity; but at the same time the length of the path along which the steam must flow is being reduced by increasing the pressure drop, so that the question, when the friction is the smallest, is not an easy one to solve.

The various considerations suggested above, explain why there is such a great difference in the number of wheels in the principal makes of turbine wheels. Prof. Bull believes, however, that the difference will grow less and less as the years pass by and experience accumulates. It must be remembered that the successful steam turbine is but very young in years, and that it will take a number of years before experimenters and designers will agree as to the propositions, and even to the main ideas in the design, which will give the best results. There is room for a very large amount of experimental work of a very intricate nature and on a large scale to determine various problems in the working of the steam turbine and until that has been done, ideas will be more or less confused as to the actual behavior of the steam in the turbine, and also as to the friction of the steam along the vanes, and of the friction of the wheels running in steam of various pressures.

Notwithstanding this lack of positive knowledge, it is not to be doubted, Prof. Bull says, that the steam turbine is still very far from having reached its greatest state of perfection, and that it has a brilliant future before it. Not all of the designs have been successful by any means; in fact, quite a few have been failures. It lies very near to ask the question: how was it possible for the steam turbine, notwithstanding the failure of many designs and of the apparent newness of the idea, to obtain such a marked success? The

reasons are of various kinds. First of all, the idea was really an old one, and more work had been done than people in general were aware of. Second, the reciprocating steam engine had apparently reached the highest perfection which it was possible to impart to it—so that inventors had to turn their efforts into a new channel if they were to expect noteworthy results. It is true enough that the efficiency of the reciprocating steam engine has been increased considerably during the last 15 or 20 years by means of the use of superheated steam; but this gain in economy is shared by the steam turbine as well, so that their relative position is not changed because of the use of superheated steam. A third reason must be sought in the fact that because of its purely rotative motion, it avoids those irregularities of motion which are inherent in the reciprocating steam engine even if it be provided with the heaviest fly wheel. A fourth reason for the rapid introduction of the steam turbine is, no doubt, to be found in the fact that it occupies much less space than its rival, a very important consideration in large cities and on shipboard. A further reason may be found in the fact that it can be regulated much more closely than the steam engine, this because of the very short time—only a very small part of a second—that the steam occupies in passing through the steam turbine, the corresponding time for the reciprocating engine being many times greater.

It will be noticed that an improvement in economy has not been given as one of the reasons for the rapid introduction of the steam turbine, and Prof. Bull is of the opinion that no such improvement has yet been shown. According to the best knowledge possessed, the present status seems to be that for the most favorable load the reciprocating engine still seems to have a slight lead, whereas for a variable load, as is most frequent in electrical lighting and traction plants, the opposite is probably the case. Prof. Bull holds that it is, however, almost impossible to express a definite opinion in this respect, as a large part of the material upon which such an opinion must be based, is furnished by the manufacturers of the turbines themselves, and which consequently cannot be taken as the very best kind of evidence. It is true that lately this kind of material has been furnished more and more by impartial observers, so that a comparison with the reciprocating steam engine, for which such a large amount of incontrovertible material is available, has become very much easier.

The reasons for the gain in economy, due to the use of superheated steam in reciprocating engines and turbines, are very far from being the same and an analysis of these will help to furnish an estimate of what can be expected ultimately in this direction from the steam turbine. In the case of the reciprocating steam engine, the gain is due to the reduction of the cylinder condensation, which is due to the difference of the temperature of the saturated steam and of that of the cylinder walls and head, which condensation is greatly intensified by the moisture in the steam adhering to the metallic surfaces. Consequently the gain is not alone due to the fact that the superheated steam is capable of giving up a certain amount of heat without being condensed, but also—and in most cases to a greater extent—because very much less heat is transmitted from the superheated steam to the cylinder than if there has been saturated steam for the same difference of temperature.

In the case of the steam turbine, this difference of temperature is necessarily very much smaller, as no exhaust steam touches the parts which come in contact with the steam on its way through the turbine. On the contrary, if the barrel of the steam turbine is well protected, the temperature of the inside of this barrel can be but very

little different from that of the steam at that particular place, hence the condensation due to this cause is certainly small compared with that in the reciprocating engine. Because of the absence of moisture on the cooler surfaces touched by the steam, this condensation will be reduced in the same ratio as for the reciprocating engine, but the difference of temperature being so small, this gain, because of the absence of moisture, can only be insignificant. However, even in the ideal case of an adiabatic expansion, condensation is inevitable if saturated steam be used, and such condensation will be prevented if the steam be sufficiently superheated so that its temperature may be lowered without its becoming saturated. In this respect the steam turbine and the reciprocating steam engine are on the same level as to the possible gain due to the use of superheated steam. So far, the analysis has unmistakably shown that the last named motor has the advantage; but there is an additional reason for the gain in economy by the steam turbine, and that is in the reduced friction which the superheated steam encounters on its way through the turbine as compared with the saturated steam. This friction is entirely negligible in the case of the reciprocating steam engine, but because of the very high velocities utilized in the steam turbine it is a very important factor in its economy. This friction is not alone due to the motion of the steam through the various wheels of the turbine, but also to the rapid revolution of the wheels in this steam. How much the friction amounts to it is at present impossible to say, although some experimental work has been done in this direction, notably by Dr. A. Stodola, of Zurich, Switzerland; but it amounts to a good deal, and there is no question but that it is very much smaller for superheated steam than for saturated.

The use of superheated steam for the reciprocating engine has been accompanied by all kinds of difficulties because of the troubles of lubrication and the expansion of the cylinder due to the high temperature. Although these difficulties have been overcome to a very large extent, yet ordinary practice has limited the superheat to within reasonable limits because of these reasons. In the case of the steam turbine these difficulties do not exist, so far as lubrication is concerned, and but to a very much smaller extent with reference to the expansion of the metal. It is therefore possible to use a very much higher degree of superheat for the steam turbine than for the reciprocating steam engine without any bad effects, and this in itself is a distinct advantage.

Thermodynamics and experience both show that if condensation can be prevented, the efficiency is a function of the differences of temperature between that of the entering steam and that of the condenser. Theoretically it should be proportional to this difference, but for actual engines it does not increase so rapidly as this would indicate, and there is probably a limit for the higher temperature beyond which the increase would be so small that it would not pay to go, even if circumstances are otherwise favorable. But this limit has certainly not been reached yet, Prof. Bull says, and consequently there should be a decided gain for the economy of the steam turbine in the use of more highly superheated steam than has been used so far, or which can be used for the reciprocating engines. Tests of turbines using superheated steam show a gain in economy of about 1 per cent. for every 8 or 9 degrees of superheat.

A steam turbine can, of course, be run non-condensing, and its efficiency, if designed for this purpose, is probably as good as that of the non-condensing engine. But it is a fact established by a large number of tests that it is very much more important to have a good vacuum for a steam turbine than for a reciprocating engine, because the gain in economy is very much greater. It is

therefore not unusual to hear of 28-in. vacuum for a steam turbine, and such high vacuum has only become possible by the introduction of improved condensers and air pumps, which owe their origin to the demands of the designers of the steam turbines. Why the gain in economy, because of a high vacuum, should be so much higher for the steam turbine than for the ordinary steam engine, is a question which has troubled a great many persons. The answer is, however, quite simple. Because of the increased condensation, it has been found unprofitable to extend the expansion down to the back pressure line in the steam engine, so that the steam, when exhausted, possesses a considerable amount of energy over and above that at the pressure of the condenser, which energy consequently is lost. In the turbine this is entirely different, as the condensation is so small that it does not need to be taken into consideration, and the energy of the steam is changed into a kinetic form, and which, in amount, is proportional to the difference in pressure between that of admission and of condenser. This energy can be utilized, except for friction losses—down to a certain minimum, corresponding to the necessary velocity of the steam when it leaves the last wheel, and which is the same, whether the vacuum is high or low. Although, therefore, there is gain in economy for the steam engine by increasing the vacuum, yet it cannot be so great as for the steam turbine, because the losses of condensation increase so much more rapidly than in the case of the turbine. Prof. Bull points out that too much money may be paid for condensing apparatus, water and running expenses in order to get an exceptionally good vacuum; the extra expense may more than outweigh the gain in steam consumption.

It is interesting to note in this connection the success achieved by Rateau in utilizing the exhaust steam from a steam hoisting engine at a mine for driving a low pressure steam turbine. As the hoisting engine was only running intermittently, he inserted what he calls a steam accumulator—a mass of iron which absorbs heat during the time when there is an excess of exhaust steam, and gives it off by evaporating water, when there is a deficiency, in this manner enabling the turbine to run continuously. An intermittently running engine like the hoisting engine can hardly be run condensing, because it takes too long a time to produce the vacuum. But a steam turbine with the accumulator can utilize the exhaust steam with a comparatively high efficiency, as is fully shown by the tests of such turbines in operation. In one test with a pressure of 14.71 lb. abs. the consumption of steam per electrical horse power per hour was only 39.97 lb. per hour, and for a pressure of 9.37 lb. absolute it was 42.78 lb.

EXTREME ACCURACY is now so frequently claimed for the daily newspapers that the following note from a Wabash paper is worth reading: "The power house will be a place of miracles to the lay mind, which may then watch electricity sucked from the air at 370 volts and multiplied to 33,000 volts by processes which electricians know as phenomena, and not as science. The reason why is apparently beyond mortal ken, but the results satisfy the commercial purposes, and the tendency of the great mass is 'to let it go at that.' The transformer that by the power that is called 'induction,' for lack of a better name, will step up the number of volts, will be enclosed in oil, and the apartment walled in will have doors so that if it gets out of repair it can be easily and safely handled. It will be dangerous to approach it within 6 ft., and it will be controlled at a safe distance by those in charge." This recalls the definition of a lightning arrester as a "device for utilizing the residual energy of the clouds," which appeared in a California paper.

Concrete Plant for the Brooklyn Anchorage of the Manhattan Bridge.

The Brooklyn anchorage pier of the Manhattan Bridge, New York, was illustrated and described in *The Engineering Record* of Dec. 17, 1904. It has extreme dimensions of about 182 x 237 ft., is 151 ft. in height and contains about 42,000 cu. yd. of concrete, 60,000 yd. of cyclopean masonry and 14,000 yd. of granite facing. The pier will be built in a pit excavated about 25 ft. below the original surface of the ground and having about 2,500 piles driven about 40 ft. to hard bottom. An elaborate plant has been provided for the excavation, pile driving, concrete mixing, masonry building and handling of masonry and materials.

ing with the other yard around the anchorage. The offices, switchboard and storage room are located in this yard and it is equipped with service tracks commanding the anchorage and with a number of travelers and derricks for handling the masonry and concrete.

Space available for the contractors' operations on the water front and vicinity was limited to an area little greater than what will be occupied by the finished bridge structure, and as it was oblique to the shore line it necessitated a peculiar arrangement of the plant. A temporary pile trestle pier about 320 ft. long was built perpendicular to the bulkhead line and was made irregular in plan, with a maximum width of 70 ft., enclosing part of the tower pier of the bridge and

and forth over a Robins' conveyor belt, 208 ft. long, and delivers sand or stone to a 6-yd. hopper, which distributes its contents on the belt. The belt delivers to a Robins bucket elevator conveyor 81 ft. long, which raises the sand and stone to the hopper bottom storage bins of about 200 cu. yd. combined capacity, in the top of the concrete tower. The bin is divided into three equal parts by two vertical partitions parallel with the belt conveyor and elevator. The center part is used for sand which is dumped directly from the overhanging elevator; both side parts are used for stone, which is diverted into either by inclined transverse aprons with their lower ends resting on the upper edges of the bin partitions and their upper ends suspended so that either



General View of Excavation for the Brooklyn Anchorage of the Manhattan Bridge, New York.

The prominent feature is that all the machinery is operated by electricity on a system described in *The Engineering Record* of August 26. A description of the pile-driving and excavating methods was published August 12 and this, together with the account here given of the concrete machinery and some special plant, affords a comprehensive description of all the apparatus which has been installed, in all at a cost of about \$75,000, with the aim of executing the work with the greatest economy and rapidity.

The plant is arranged in two groups, on both sides of Plymouth St., parallel with the water front, which is crossed by overhead service tracks. On the shore side are docks, loading, unloading and storage facilities and the concrete-mixing plant, with several lines of service track connect-

providing for mooring alongside within the property line four or five large barges on which cyclopean stone, broken stone and sand are delivered and stored. Provision is also made at the end of the wharf to moor a scow to receive the excavated material. Privileges were secured for mooring to the adjacent pier a boat on which cement is received and stored and from which it is unloaded by a derrick on a trestle built above the pier shed. By this arrangement, materials are chiefly stored on the boats by which they are delivered and are removed at convenience as the work progresses and requires them.

Broken stone and sand are unloaded by a 1½-yd. clam-shell Hayward bucket, operated by a traveling derrick on a 12-ft. gauge track on the deck of the pier. The derrick moves back

of them may be made to receive the contents of the elevator buckets and deliver them to their respective bins, one or both aprons being out of service all the time. On the walls of each bin there are two 15-ft. coils of 1-in. steam pipe, to warm the contents of the bin in cold weather, and the bottoms of the bins are provided with eight symmetrically arranged chutes which deliver through special gates to four 4 x 4-ft. steel mixing hoppers on the upper floor of the tower. One sand and one stone chute deliver to each hopper and when the latter are filled to the required mark a measured quantity of water is turned on through a pipe and the requisite number of cement bags are emptied in the hoppers by hand.

Bags of Helderberg Portland cement are un-

loaded from the boats in lots of twelve by a light traveling derrick which moves on the elevated platform over the shed on the adjacent pier. About thirty lots can be hoisted in an hour and are delivered on push cars over a 36-in. track to the cement house adjacent to the mixing floor of the tower. Here about 4,000 bags of cement can be stored and are kept as a reserve in case of any interruption of the supply, the bags usually being unloaded from the car as they are required for mixing.

The mixing hoppers have 12x12-in. horizontal sliding gates operated by horizontal levers just above the surface of the floor. Four men control these and simultaneously open them to discharge the contents of the hoppers to the first mixing hopper, 6 ft. in diameter, on the next floor about 6 ft. below. This hopper has a gate which is usually kept open; it ordinarily requires no attendant and the materials pass directly through it into the second similar mixing hopper, also with an open gate, and thence into the lowest hopper about 10 ft. in diameter, which is large enough to hold 4 yd. of concrete and thus affords sufficient storage for two or three batches of concrete and provides for the slight delays in conveying it away without interrupting the regular progress of mixing.

The hopper discharges into 2-yd. Cyclopean buckets seated in pairs on the motor cars and trailers. From four to eight buckets are usually taken at one trip, carried on the elevated track across Plymouth St. to the anchorage pier, and delivered to the traveler derricks which deposit them where required in the anchorage masonry. This concrete plant has an estimated capacity of 600 yd. in 10 hours, but the product will be limited by the rapidity with which the concrete can be removed from the mixer. It requires nine men to operate it, including those employed unloading the stone, sand and cement boats and six men employed in the mixing tower.

The derrick for unloading the cement boats has a 15-ft. mast, a 21-ft. boom and two stiff legs with bolted steel plate connections to the sills of a 17x14-ft., four-wheel platform counterweighted by the Lidgerwood single-drum hoisting engine, which is operated by a 6-h.p. motor.

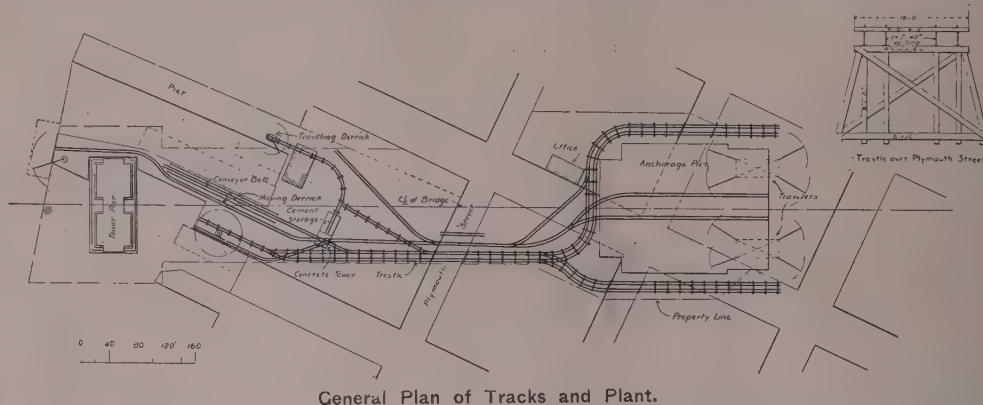
The derrick used for unloading sand and broken stone has a 16-ft. mast and a 35-ft. boom of 6 tons capacity. The mast is seated on one corner of a 14x30-ft. platform mounted on five double-flange, 24-in. wheels, two under the foot of the mast and one under each of the other corners. The wheels are set between pairs of 8x14-in. longitudinal sills, which form the chords of a horizontal Howe truss, three panels long, with 6x8-in. diagonals. The perpendicular members are each made with one 12x14-in. timber and one 1-in. rod. The two stiff legs have steel connection plates bolted to them and connected to similar bearing plates on the sills. All timbers are 12x12-in. and a 6-ft. bull wheel is bolted to the foot of the mast. A stationary derrick of 10 tons capacity is installed on the dock for handling the cyclopean stone. It has a 60-ft. boom supported near the middle by the topping lift tackle, which is made fast to a bridle. Both of these derricks are fitted with standard irons and are made by Thomas Carlin's Sons, Allegheny, Pa.

The 24-in. conveyor belt is set close to the pier deck except at one end, where it curves upward to a height of about 7 ft. and discharges into a chute delivering to the buckets of the elevator. It is driven at a speed of 326 ft. per minute by a 5-hp motor near the upper end, which runs at a speed of 1,500 revolutions per minute. Sand and broken stone are delivered from the hopper to the belt by an inclined chute suspended from the hopper frame. The inclination of the chute can be varied by adjustments in the suspender rods, and it is given a longitudinal vibratory motion by

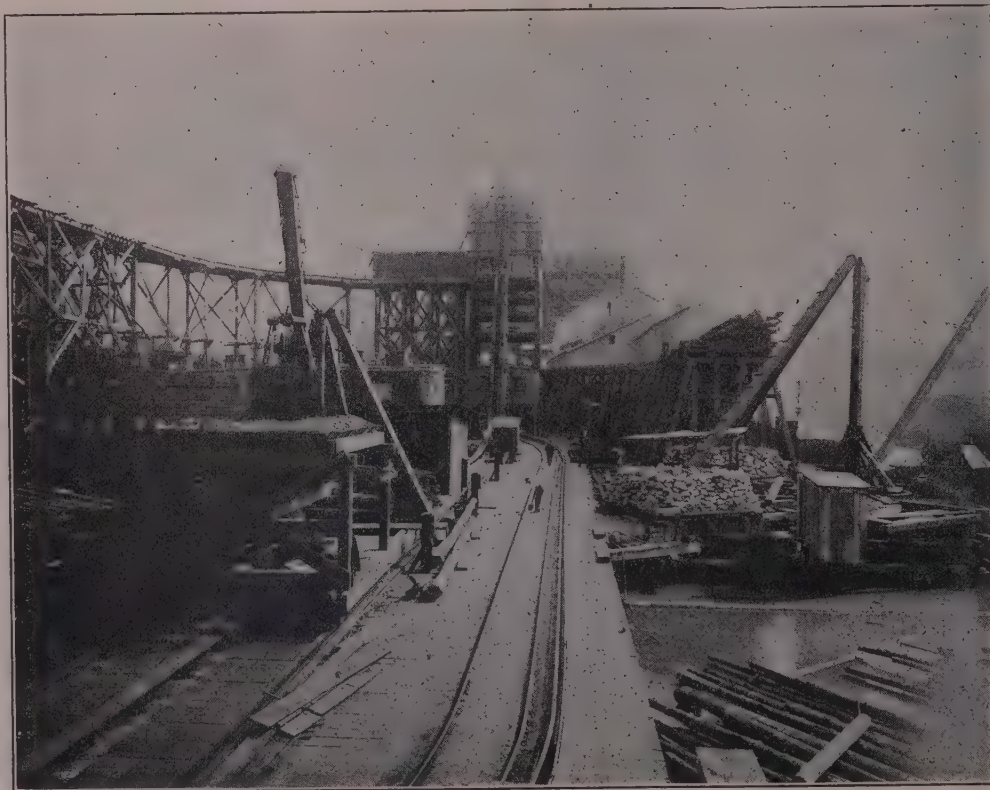
a pair of connecting rods attached to a crank driven by a 3-h.p. motor making 1,600 revolutions per minute and belted and geared down to 76 strokes for the crank shaft. The inclination of the chute is such that when the vibrator is stopped the sand and broken stone will not run off and it effectually closes the receiving hopper. The speed of discharge to the belt is easily regulated by varying the speed of the vibrator or the inclination of the chute. The elevator has buckets spaced 13 in. apart and is driven at a speed of 186 ft. per minute by a 15-h.p. motor seated on the measuring floor of the concrete tower and running at a speed of 1,070 revolutions per minute. This ap-

The upper and lower tiers are simply braces, the other six tiers are floored. The outside panels between the columns and the beams are X-braced by timbers on two opposite sides of the tower. The tower carries an estimated maximum load of about 400 tons and the structural steel in it weighs about 37 tons. It was designed and erected by the J. H. Gray Company, New York.

A Goulds pump with a capacity of 50 gallons per minute is driven by a 3-h.p. motor, automatically started and stopped by a Cutler-Hammer tank controller and delivers the water from a 4-in. well 65 ft. deep, through a 2½-in. pipe 450 ft. long to a pair of 700-gal. wooden tanks on top of



General Plan of Tracks and Plant.



General View of Equipment at Wharf for Handling Materials.

paratus has a capacity of 70 yd. per hour and was installed by the Robins Conveying Belt Company, New York.

The steel tower for the Hains concrete mixer is 20 ft. square and 70 ft. high, and is made with four vertical columns on each of two opposite sides. Each column is a 12-in., 31-lb. I-beam with gusset plates riveted to the flanges at the lower end to distribute the load over a 24x24-in. base plate seated on wooden distributing beams 4 ft. long. These beams transmit the load to 4x5-ft. grillages of solid 8x10-in. timber laid on a continuous course of 5 ft. wide of longitudinal timbers running across the full width of the tower. The vertical posts are connected by eight tiers of horizontal I-beams riveted to bracket or shelf angles.

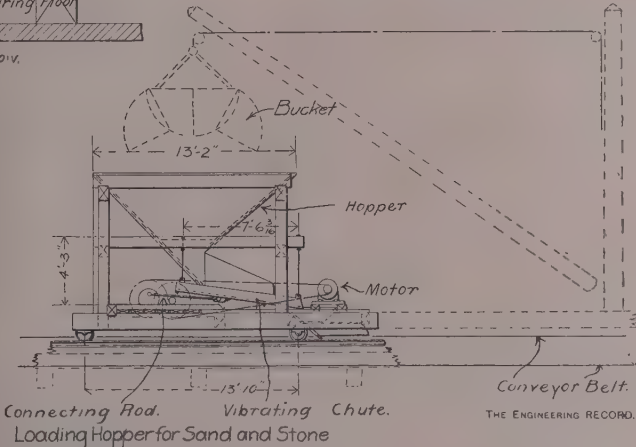
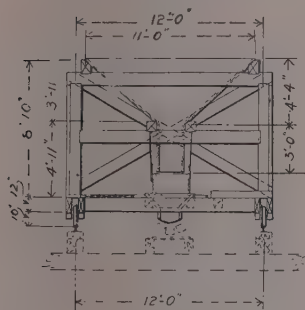
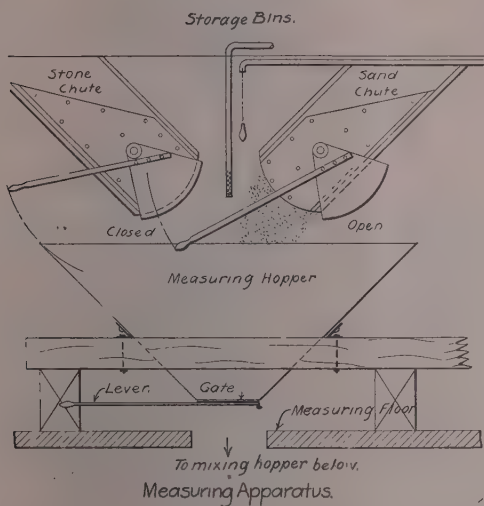
the sand and stone bins. The tanks have steam coils to warm the water in cold weather and are fitted with overflow, tell-tale and ball cocks. Their discharge pipe is arranged either to fill the four 20-gal. syphon flush tanks, one for each measuring hopper, or to discharge a fixed quantity of water directly to the hoppers, the change from one system to the other being quickly effected by the operation of a single valve. The flush tanks are filled through ball cocks attached to an adjustable gauge rod, so that by moving a set-screw they can be made to provide any required amount of water from 5 to 20 gal. for each discharge. A gate valve on the discharge pipe above the branches to the hoppers is opened by hand and has its stem connected to an automatic clos-

ing device. An oil dash-pot has its plunger arranged to engage a catch and close the valve at any required point of the stroke, and as the speed of the stroke is uniform this enables the amount of discharge for the four nozzles to be regulated from 20 to 200 gal. Over each hopper there is a perforated pipe with a spray nozzle controlled by a handle on an operating wire run through a protecting tube.

The lower part of the pier is solid concrete. About 25 ft. above the footing there is an archway 46 ft. wide and 46 ft. high to carry the street through the pier. Up to the top of this pier the



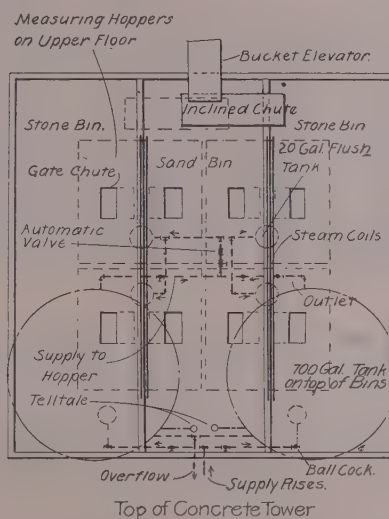
Collector Shoe on Car.



Some Details of Concrete Plant.

and install three rectangular steel towers about 80 ft. high, which will be equipped with derrick booms commanding the whole anchorage and will be built permanently into the concrete masonry, giving it increased strength. These towers could not be advantageously used at first on account of the necessity for clearing the main arched passage through the pier, so the two methods will be combined. The travelers have already been installed for use in the excavation, in the positions indicated on the general plan, and will remain stationary until the excavation and pile-driving is completed and the falsework built to the front end of the pier to carry their tracks.

Each traveler has a 28x50-ft. horizontal timber platform mounted on twelve wheels. At each corner there is a Carlin 10-ton derrick, similar to the one already described, with a 12x14-in. boom 60 ft. long. Each derrick is swung by a bull wheel and is operated by an independent Lidgerwood hoisting machine seated on the traveler platform in an oblique position so as to take the diagonal lead from the tackles. The service tracks shown crossing the anchorage will be discontinued and stone and concrete will be delivered to the travelers from the tracks on ground level on both sides



Buck, consulting engineer; Mr. H. D. Robinson, engineer in charge, and Mr. D. E. Baxter, resident engineer. The contract was awarded to the Kosmos Engineering Co., Brooklyn, Mr. E. H. Baillée, president; Mr. Gustave Kauffman, chief engineer, and Mr. C. C. Harley, electrical engineer.

A Reinforced-Concrete Double-Track Railroad Arch Bridge.

A bridge is now being constructed in a 20-ft. embankment to carry the two main-line tracks of the Central R. R. of New Jersey over a highway near Vulcanite, N. J., to replace an abandoned grade crossing. The structure is about 70 ft. long over all and 32½ ft. wide, exclusive of wing walls, and has a height of about 21 ft. from the bottom of the foundation to the top of the arch. It consists, as shown in the general drawings, of a main 30-ft., 5-center span over the macadam roadway and gutters, flanked by two 7-ft. arches over the cinder sidewalks. It is of monolithic construction, except for the expansion joints. The faces of the arch are carried up to track level with heavy reinforced spandrel walls, the entire surface of which, together with the upper surface of the arch, are waterproofed. Above the arch ring the space behind the walls is backfilled with coarse material rammed in 6-in. layers and covered with broken stone ballast to receive the tracks.

The arch was proportioned for a dead load consisting of the concrete structure with an estimated weight of 160 lb. per cubic foot, a backfill of 100 lb. per cubic foot and 140 lb. for rails, ties and ballast per square foot of the horizontal surface. The live load consists of an 187½-ton locomotive, followed by a 5,000-lb. per foot trainload on each track, with axle loads spaced as indicated by the diagram. The concrete in the center arch ring between skewbacks is made with 1 part dry compressed American Portland cement, 2 parts sand and 4 parts broken stone; all other concrete is made of 1 part cement, 2½ parts sand and 5 parts stone broken to 1 in. or less. The concrete was proportioned for a working compression stress of 600 lb. per square inch, including temperature stresses, and all tensile stresses are provided for by round bars of medium open-hearth structural steel conforming to the manufacturer's standard requirements for railroad work, and by 6-in. expanded metal, lapped at least 8 in. The steel rods are proportioned for a working tensile stress of 12,000 lb. per square inch and to provide for temperature stresses due to a variation of 70 deg. Fahr. The modulus of elasticity of concrete and steel is assumed to be 1,400,000 lb. and 28,000,000 lb., respectively.

It is required to construct the new bridge without interrupting the railroad traffic, and for that purpose both the tracks in a section of the line 588 ft. long at the bridge site have been moved transversely to a maximum distance of about 30 ft. from their original position, forming a 10-deg. curved turnout clearing the new span and supported in the center on falsework trestle bents. In the space thus vacated the original embankment has been excavated to a level just below the springing lines of the arch, as indicated in the side elevation of the latter, and trenches have been dug to solid rock for the footing of the abutments and wing walls.

In order to make the work practically continuous and secure a monolithic structure, the operations will be carried on in the following sequence: First, the concrete foundations will be placed, then the southerly wing walls will be constructed; then the abutments, arch ring, the parapets, and

concrete and face masonry will be handled by two travelers running over the pier from front to rear and back and jacked up as the pier rises. At first these travelers will move on a falsework trestle built up from the foundation, wells being left in the masonry to clear the posts and filled in with concrete or grout after the falsework is removed. Above the top of the large arch the masonry is very much cut up by numerous irregular open spaces, so that it would be very difficult to use the traveler, and it is intended to abandon it at a height of about 70 ft. above the footings

of the pier; the forward booms will be used for handling stone and the rear booms for concrete, and it is estimated that the two travelers should lay an average of 500 cu. yd. of masonry in each 8-hour shift. As has been noted in the preceding articles, all the plant is operated by General Electric Company's motors, using a 220-volt current from the mains of the Brooklyn Edison Company.

The designs and execution of the work are under the direction of the Bridge Department of New York, Mr. George E. Best, commissioner; Mr. O. F. Nichols, chief engineer; Mr. R. S.

finally the northerly wing walls; backfill between parapets being made with material taken from the embankment within the limits of the highway. The excavation to subgrade of the highway and the construction of the latter, together with the sidewalls, will be done after the bridge is opened to railway traffic.

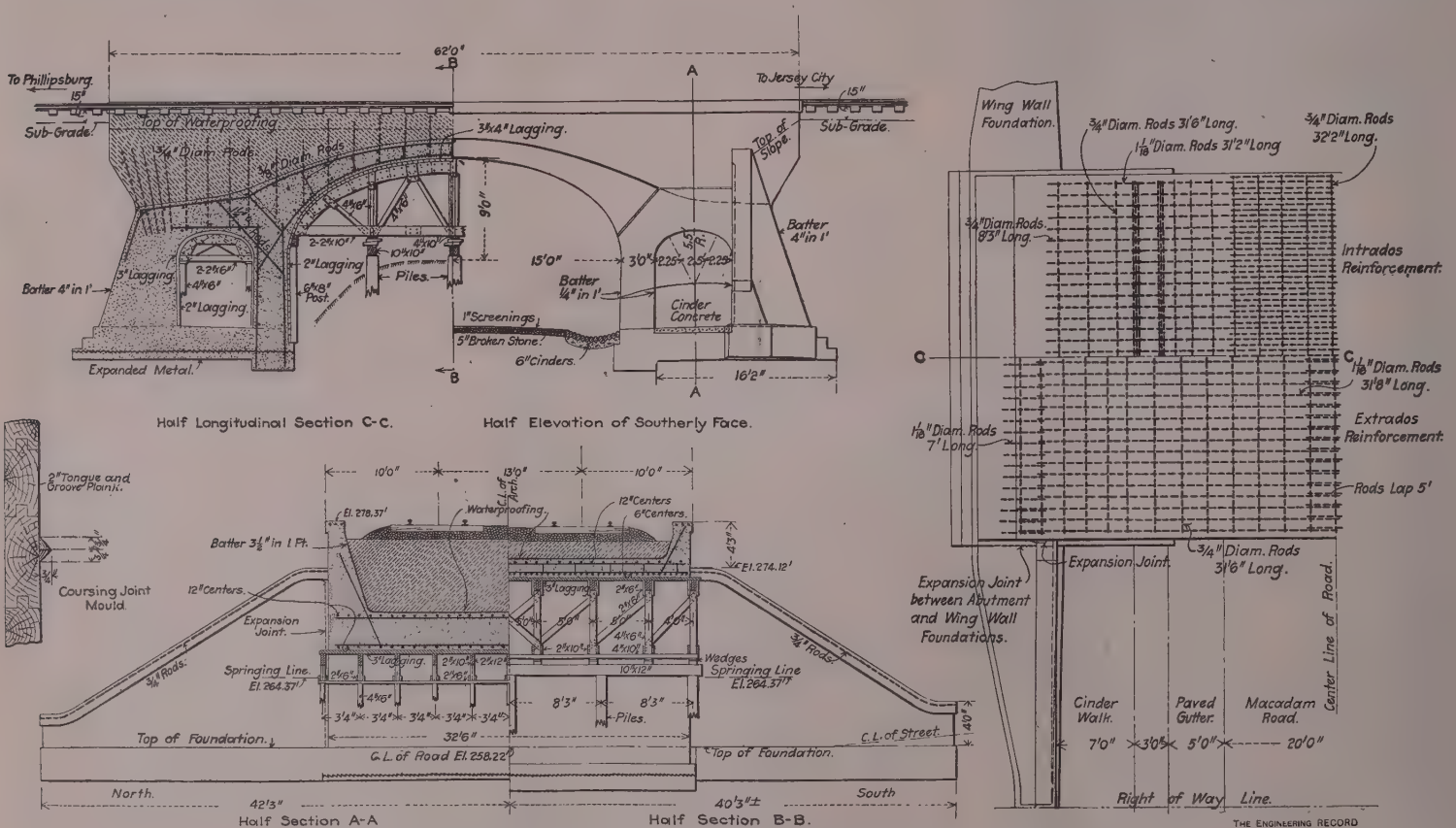
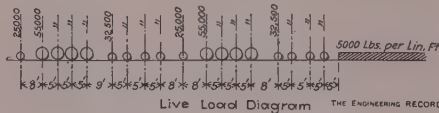
Each of the sections of concrete will be made by continuous work, and except at the foundations the only joints in the structure will be those at the intersection of the wing walls and abutments, where tongue-and-groove expansion joints will be made. The skewback joint and the intersections between the faces of the parapets and the extrados of the arch and the top of the abutments will be roughened with a steel point. Where these joints intersect the finished surface they will have a V-shaped opening made by fastening to the molds two triangular strips, the first of which is put on the mold, as shown in the detail, with its upper face flush with the surface of the concrete. When the second section of concrete is

concrete and flush the cement mortar to the surface. The concrete in the foundations, wing walls, abutments and parapets will be built and rammed in horizontal layers not more than 6 in. thick. The concrete in the center arch wing will be built in layers, which, in the opinion of the engineer, will allow the completion of each section the full width of the arch and the starting of the next section before the first has had time to set. Concreting will be started simultaneously at each skewback ring, and will be continued without intermission until the completion of the entire ring. No concrete will be allowed to be deposited under

necessary for all of the forms and centers for the abutments and arch ring to be erected before the concreting is commenced in the abutments. As soon as erected the forms will have their finished inside surfaces painted with petrolatum, a second coat of which will be given just before the concreting is commenced. The waterproofing on the top of the arch and abutments will be made with four alternate layers of waterproofing felt laid with a 9-in. lap in coal tar.

The forms will be made of 2-in. dressed lumber, well braced, and the arch centers will be supported on the falsework piles with pairs of white oak wedges on each support. They will be set $\frac{1}{2}$ in. high at the crown and will remain in position for two weeks after the completion of the arch ring, after which they will be lowered by very small amounts at intervals of a few days until the centers are clear of the concrete.

The principal quantities involved are 4,500 cu. yd. excavation, 840 cu. yd. concrete, 2,250 sq. ft. waterproofing, 180 sq. yd. macadam pavement and



General Drawings of the Reinforced Concrete Railroad Bridge near Vulcanite, N. J.

built a reversed duplicate strip will be placed in contact with the first strip. This allows the concrete to be smoothly troweled at the joint and provides a very smooth coursing.

The reinforcing steel consists principally of longitudinal $1\frac{1}{8}$ -in. rods and transverse $\frac{3}{4}$ -in. rods parallel to the upper and lower surfaces of the arch ring, as shown in the plans, and of $1\frac{1}{4}$ -in. and $\frac{3}{4}$ -in. rods in the abutments, which have also a layer of 6-in. expanded metal 6 in. above the bottom of their footings. The reinforcement is secured by wiring the longitudinal and transverse rods at intersections and by tying the rods in the extrados and those in the intrados together with $\frac{3}{8}$ -in. rods and $\frac{5}{8} \times 2$ -in. steel struts. The rods in the intrados are spaced 3 in. from the surface by wooden wedges, removed as the concreting progresses.

The concrete will be mixed very wet, and most of it will be deposited without tamping. It will be worked against the finished surfaces and around the reinforcement by forks or shovels so as to force the stones back into the body of the

water or in freezing weather. The foundation and abutment surfaces in contact with the other sections of the structure will be sprinkled with broken stone, lightly rammed to bond with the next section. Before the latter is commenced this surface will be thoroughly cleaned with brushes and water and covered with a thin layer of cement mortar.

The continuous laying of the arch ring concrete will be conducted as it was for the 54-ft. span at Newark, which was described in The Engineering Record of August 6, 1904. In this bridge the arch ring section of the structure was built in 60 hours' continuous work. During this time the surfaces of the layers of concrete were kept constantly green and were never exposed more than three-quarters of an hour before the next layer was applied and worked into the first one with forks and spades. This method was very successful and secured a structure with a smooth, uniformly colored surface without cracks.

On account of the reinforcement bars bonding the arch rings and abutments together it will be

90 sq. yd. paved gutters and 25,000 lb. of reinforcement steel. The estimated cost of the completed structure, including the maintenance of railroad traffic, is \$13,000. The work has been designed and is being executed under the direction of the engineering department of the Central R. R. of New Jersey, Mr. Joseph O. Osgood, chief engineer; Mr. J. J. Yates, assistant engineer, and Mr. Austin Lord Bowman, bridge engineer. The contract has been let to Mr. Stacy B. Opdyke, Jr., and work is now under way.

THE NUMBER OF COLLISIONS AND DERAILMENTS which occurred on the railways of the United Kingdom in 1904 exactly equals the average of the previous 24 years, according to "The Engineer" of London. Taken by itself, this shows no improvement, but taking the train mileage into account, it appears that whereas in former years one collision or derailment occurred on the average for every 1,494,875 train miles run, there was in 1904 one for every 1,829,327 train miles, a reduction in frequency of 18 per cent.

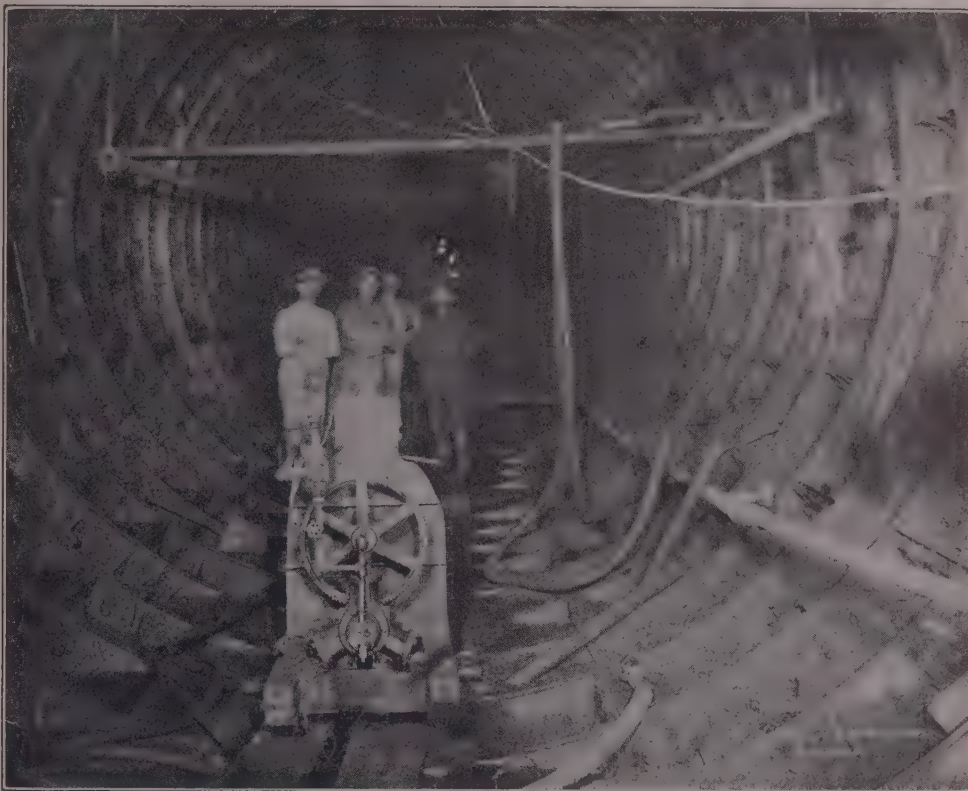
Progress on the Battery Tunnel, New York.

The New York and Brooklyn tunnel of the Rapid Transit Railroad system extends from Battery Park, New York, to Joralemon Street, Brooklyn, and consists of two single-track tubes with cylindrical cast-iron shells 28 ft. apart on centers and 15½ ft. in clear inside diameter. They have a total length of about 6,750 ft. each and a maximum depth of about 94 ft. from mean high-water level to base of rail. The maximum depth of water is about 50 ft. and the tunnel is driven through rock, clay, boulders, sand, etc., with a roof from 10 to 30 ft. deep under the river bottom. The headings were commenced from the Brooklyn shafts on July 10, 1903, and from the New York shafts April 9, 1903, and the work has been carried on under pneumatic pressure both in rock and earth excavation. In each of the two Brooklyn headings, where the tunneling is in earth, there have been installed an hydraulic shield and erecting machine, pumps and grouting apparatus, as described in The Engineering Record of March 5 and March 12, 1904. Rapid progress has been made by the methods already described and on August 15, 1905, the headings had advanced under the river to positions 650 ft. and 50 ft. beyond the Brooklyn bulkhead lines and 1,520 ft. and 1,500 ft. beyond the New York bulkhead line for the north and south tubes, respectively. After the headings had approached the bulkhead lines on the Brooklyn shore, two additional shafts about 45 ft. deep were sunk in Joralemon Street, about 1,050 ft. from the original shafts, where the tunnel was commenced. These were made with steel caissons and intersected the finished tunnel rings. The latter were cut out and connection was thus established close to the shore line between the power plant and the tunnel and the original shafts were aban-

At present the pressure in the Brooklyn headings is only about 21 lb.; in the New York headings it is about 27 lb., amounts which in both cases are substantially equivalent to the hydraulic pressure at the roof of the tunnel and do not in-

the headings at the different pressures required.

Each tube requires an excavation of 8¾ cu. yd. earth per linear foot and its shell weighs about 4,000 lb. per linear foot, for the segments which have a minimum thickness of 1½ in., and 4,550 lb.



Grouting Machine Used on Battery Tunnel.



General View of Tunnel with Concrete Lining in Place.

doned. The air lock was moved forward to a position just beyond the new shaft, and after excavation had progressed about 480 ft. from it a second lock similar to the first was installed, and will be advanced from time to time as the heading recedes from 200 to 600 ft. beyond it.

clude the additional pressures which would be due to the increased head from the roof to the bottom of the tunnel. Two locks are similarly installed in each of the tunnels on the New York side and a maximum of about 15,000 cu. ft. of free air per minute is forced into all four of

for the heavier sections which have the same thickness, but are made heavier in the flanges. Work is prosecuted continuously by three 8-hour shifts of men. The total force, including the three shifts and the men on the surface, is an average of about 350 men, and the average progress in each heading is 75 ft. per month. The most rapid progress has been nine 22-in. rings in 24 hours and 510 ft. of heading progress for all tubes in one month. Notwithstanding the joints of the cast-iron segments are all faced, there is a slight leakage between them, and before the tunnel is lined they are all carefully examined and the bolts are tightened and defective ones are replaced, and grummets are inserted where necessary.

On the shore side of the Brooklyn shafts about 600 lin. ft. of concrete lining for each of the tubes has been put in place. This is composed of 1:3:4 concrete made with Giant Portland cement and ½-in. broken stone, mixed by hand as required, and placed so as to fill each segment flush with the flanges, after which the concrete side benches containing the electric cable ducts are built.

The sequence of operations in placing the concrete lining and benches is as follows: After the segments in the bottom forming the invert between the benches have been filled flush with concrete, a movable working platform about 15 ft. long is set up at the middle height of the tube, running on detachable rollers bolted to the cast-iron shell. On this platform semicircular ribs of 4x3-in. T-irons are erected at each joint between rings. Their stems are inserted in the joint, and their flanges form a support for short pieces of 2x1 lagging, cut to the length of the ring so as to fit between the ribs. The concrete is filled in the narrow space between the flanges as the lagging strips are placed three or four at a time and wedged tightly in place. The concrete filling of each segment is complete in itself, being

placed independently, and is kept in place by its voussoir action and by its bearing on the heads of the bolts connecting the segments. Forms are struck in from 24 to 48 hours and a wash of Portland cement grout is applied to the surface, after which the platform is rolled ahead to build a new section. After the invert and roof plates have been filled forms are set up and the concrete side benches each containing seven $3\frac{1}{2}$ -in. single-tube conduits are built to a height of about 6 ft. above the lowest part of the tube. These sections are built in lengths of about 30 ft. and carried along on both sides of the tube at the same time. Finally the voids just above the bench on each side, left on account of the platform rollers, are filled and plastered, making a smooth and regular interior finish in which the joints are not readily perceptible.

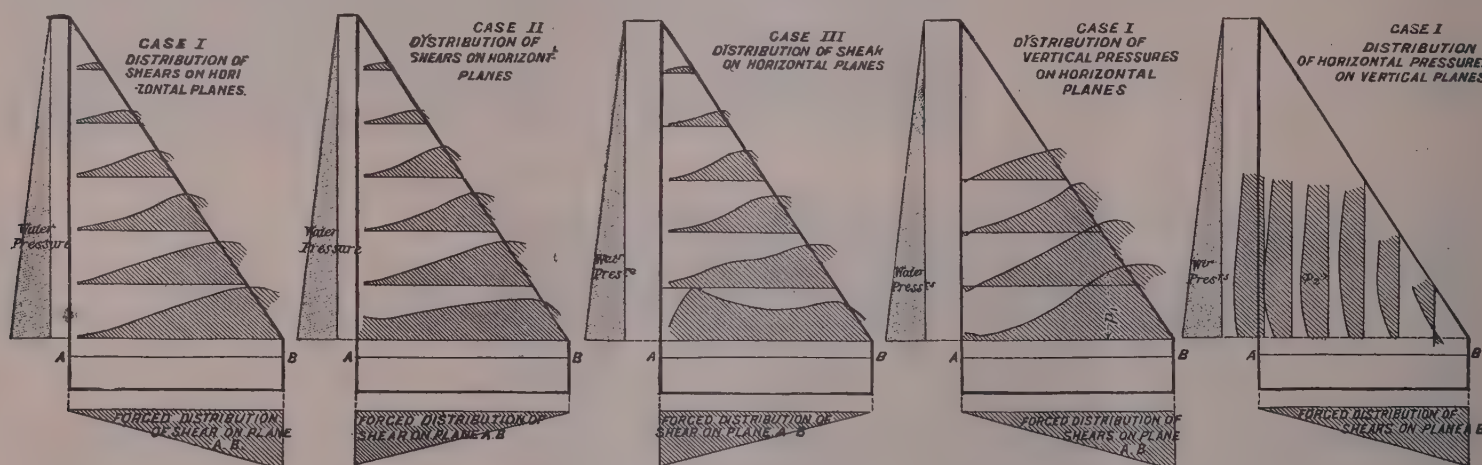
Considerable new plant has been added, especially on the Brooklyn side, since the original installation which was described in the previous article. The principal machines on the Brooklyn side now comprise one large Ingersoll-Sergeant air compressor, rated at 700 h.p., with a capacity of 3,500 cu. ft. free air per minute; three duplex Ingersoll-Sergeant air compressors, each with a capacity of 3,600 cu. ft. free air per minute; two small class A Ingersoll-Sergeant air compressors, each with a capacity of 1,200 cu. ft. free air per minute; two 30-kw. Keystone generating sets supplying currents for lighting; five Gem City hori-

Experiments With Models of Dams.

Considerable attention has lately been directed to the experimental study of the stresses in dams. For this purpose rubber or an equivalent elastic substance has been employed by some investigators, and these models have indicated the points where the greatest strains occur. In actual waterworks structures the masonry dam has a specific gravity exceeding two, and consequently the stress on the rubber model should be reduced to equivalents of those exerted by a fluid of a density less than half of that of the rubber. If this is done the distortions of the rubber become so small as not to be appreciable, and they must be magnified five to ten times before they can be studied, a step which reduces the equivalence of the test conditions to those of masonry and water. It occurred to Messrs. J. S. Wilson and W. Gore that such experiments could be improved by increasing the effective weight of the rubber so that, compared with the forces representing fluid pressure, it would have a virtual density of 2.25 or more. It also seemed evident that if as many of the unknown influences as possible could be eliminated or given definite values, careful experiments with elastic models would be a useful check on theoretical investigations. Accordingly, the base of their model is not fixed to a rigid support, and means are provided for resisting the total horizontal thrust by a series of definite forces acting

ing the pins simply through the rubber, is to facilitate the ruling of the lines on the face; the lines are ruled after the tubes are in place, and local distortions, due to the tubes stretching the rubber, do not affect the evenness of the lines. Lead weights are hung on the pins passing through the rubber, in the manner indicated by the section *CD*. The pins are made of various lengths, so that each weight hangs quite independently of all the others. A layer of small shot, or steel balls, is put between the base of the model and the support. This arrangement not only prevents the support from offering any appreciable resistance to the thrust of the water pressure, but permits the rubber to stretch, or contract in itself along the base. The fluid pressure acting on the face of the dam is divided into six sections of equal depth, and reproduced by the six forces, W_1, W_2 , etc., equal to and acting along the resultants of the pressures on each section. The forces are distributed over each of the sections of the face by the small bearing plates indicated.

Along the line *AB*, in this instance $\frac{1}{3}$ in. below the limit of the dam proper, six tubes and pins are passed through the rubber, and the whole of the horizontal thrust is taken up by definite forces, S_1, S_2 , etc., applied at these points. It is obvious that so long as the total of the six forces S_1, S_2 , etc., is equal to the total of the six forces W_1, W_2 , etc., representing the water pressure, the model



Diagrams Showing Distribution of Shears and Pressures in the Model Dam.

zontal fire-tube boilers, of 100 h.p. each; two Heine boilers of 250 h.p. each.

On the Manhattan side the principal items of plant are as follows: One large Ingersoll-Sergeant cross-compound air compressor, rated at 600 hp., with a capacity of about 3,000 cu. ft. free air per minute; two small class A Ingersoll-Sergeant air compressors, each with a capacity of 1,200 cu. ft. free air per minute; one 17-kw. Keystone, one 15-kw. General Electric and one 40-kw. Westinghouse generating sets for lighting current; two Heine boilers, each of 300 h.p.; two Hogan boilers, each of 300 h.p.

The work is being executed under the supervision of the Rapid Transit Railroad Commission, Mr. George S. Rice, chief engineer; Mr. Alfred Craven, deputy chief engineer; Mr. Robert Ridgway, division engineer. The contract for this section of the work was awarded to the Rapid Transit Subway Construction Company and sublet by them to Mr. Andrew Onderdonk, who assigned it to the New York Tunnel Company, Mr. Walton I. Aims, chief engineer; Mr. John Kergan and Mr. T. J. Brown, superintendents.

QUICKSILVER was produced in greater amount in the United States in 1904 than in any other country. Spain has heretofore held first place.

along the base. By varying the magnitudes of the latter, the distribution of shear can be forced to follow approximately any law. The apparatus was exhibited before the Institution of Civil Engineers recently, and was described by the designers in a recent number of "Engineering," from which the following notes are taken:

The model section rests on a short beam secured to a trestle, to which the guide-pulleys are also attached. The block of rubber represents a dam of triangular section, the width at the base being two-thirds the height. With masonry of a density of 2.25 (neglecting alteration in shape due to distortion), the lines of resistance of such a section, with reservoir full and empty, lie along the down-stream and up-stream middle-third lines, respectively. The rubber model is 7 in. high and 4 in. wide at base; the lower rectangular portion, or substratum, 1 in. high, is not subjected to water pressure, and is not part of the dam proper. The model is 1 in. thick.

The section is divided into imaginary rectangular and triangular elements, as indicated by the dotted lines. Through the centre of gravity of each element a hole is made, and a piece of tube of small diameter inserted. Through these tubes pass the pins on which the weights are hung. The object of having the tubes, in place of pass-

ing the pins simply through the rubber, is to facilitate the ruling of the lines on the face; the lines are ruled after the tubes are in place, and local distortions, due to the tubes stretching the rubber, do not affect the evenness of the lines. Lead weights are hung on the pins passing through the rubber, in the manner indicated by the section *CD*. The pins are made of various lengths, so that each weight hangs quite independently of all the others. A layer of small shot, or steel balls, is put between the base of the model and the support. This arrangement not only prevents the support from offering any appreciable resistance to the thrust of the water pressure, but permits the rubber to stretch, or contract in itself along the base. The fluid pressure acting on the face of the dam is divided into six sections of equal depth, and reproduced by the six forces, W_1, W_2 , etc., equal to and acting along the resultants of the pressures on each section. The forces are distributed over each of the sections of the face by the small bearing plates indicated.

The diagram shows the forces S_1, S_2 , etc., arranged so that the intensity is a maximum at *A*, and decreases uniformly to zero at *B*.

The results of the experiments on the triangular section are obtained with a magnification of 25 of the weights and forces; that is, each element of the model has so much weight added that the total weights 25 times the weight of that block if of masonry with a specific gravity of 2.25. The water-pressure forces are magnified to the same degree, so that they represent a fluid 25 times as heavy as water. Measurements of the angles and distances on the model, being difficult to make direct on account of the pins and connections, they are more conveniently made by the aid of photography. The model, with its fine, evenly ruled lines, is photographed direct on a large plate, so that all dimensions are nearly

doubled. In order to be as free from error as possible, the camera is carefully focussed and fixed, and, without further movement, photographs are taken of the model, first when unloaded, and then when all the forces are acting. If the amounts by which the angles are distorted, along the different horizontal sections, are measured and plotted vertically, curves, of which the ordinates are proportional to the intensity of the shear, are obtained. Such curves are given, representing Cases I, II and III, respectively.

In Case I, the shear-resisting forces are arranged so that the intensity of shear is a maximum at *B*, and decreases uniformly to zero at *A*; this corresponds with the usual assumption. It will be noted that the triangular form is not main-

shot by a vertical load applied to the first shear-pin. The effect of this on the shear curve along the lower section is to convert the tendency of the intensity to rise near the up-stream edge, observable in Case II, into a maximum near that point. The curve on the next higher plane appears to be affected slightly also, but, high up still, the curves remain similar in shape to those in Case I, though with rather greater maximum values.

Curves of the intensity of vertical pressures on horizontal planes and of horizontal pressures on vertical planes are given. In each case the intensity of pressure is proportional to the vertical or horizontal distance from the section line to the curve. The vertical pressures p_1 on horizontal

made very near the edges are not altogether reliable, but Messrs. Wilson and Gore expect to overcome this difficulty in future experiments.

The method described above has been applied in the present instance to a section of simple theoretical design rather than to the section of an actual structure, in order that it may be more clearly indicated how the results differ from the usual theoretical assumptions. Applied to the section of an actual dam and its substratum or foundations, with vertical water pressures acting on the up-stream portion of the latter, considerable additional information can be obtained regarding the stresses near the up-stream toe. It is expected that this method, applied to retaining walls and arches, will afford a means of testing the validity of assumptions usually made in their design.

New Turbo-Generator Plants of the Clyde Valley Electrical Power Co., Ltd.

The turbo-generator plants of the Clyde Valley Electrical Power Co., Ltd., recently installed at Yoker and Motherwell, near Glasgow, Scotland, involve an interesting departure from what may already be termed accepted practice in this country in the design of steam turbine generating stations. It has been the trend of practice in turbine plant design here to make use of the cross-firing-aisle arrangement of boiler room, on account of the relatively smaller area occupied by the turbine units than that of the boilers necessary to operate them. In these new stations, however, there was secured by means of a compact arrangement of boilers and a longitudinal arrangement of the horizontal turbines in a long, narrow operating room, a reversion to the more usual station layout with the single row longitudinal arrangement of boilers, familiar to reciprocating-engine plant practice. The plants involve, further, unusual features of station layout in the assignment of a large space at one end of the operating room to switchboard rooms, offices, etc.

The Clyde Valley Company was organized for the avowed object of assisting manufacturers in the district surrounding Glasgow to maintain the high position in industrial and engineering importance they have for many years held and aiding them in competing as keenly as ever in the world's markets, by the distribution of a low-priced and reliable power supply. The company, which was initiated by local enterprise, was incorporated in 1901, and has obtained powers over an area extending along the Clyde Valley from Craigdonn and Port Glasgow on the west, to Lanark and Shotts on the east. This area, which comprises about 750 square miles, contains the most important manufacturing and coal producing districts in Scotland. The company has taken over the provisional order which was granted to the Burgh of Clydebank in 1901; this was sanctioned by Parliament in 1904 and enables the company now to supply electricity for both power and lighting in that burgh, for which purpose a special plant has been installed. The city of Glasgow and the burghs of Govan, Patrick, Port Glasgow, Paisley and Hamilton, although actually situated in the above area, are not included in the company's schedule unless any of them should elect to take a supply.

Under the act of Parliament the company was empowered to acquire land for the erection of generating stations at Yoker and Motherwell, five miles and fifteen miles out of Glasgow, respectively; and in September, 1902, a contract was entered into with the British Westinghouse Electric & Manufacturing Company, Limited, for the erection and equipment of these two stations and the various sub-stations that are dotted over the area. The Yoker generating station of the

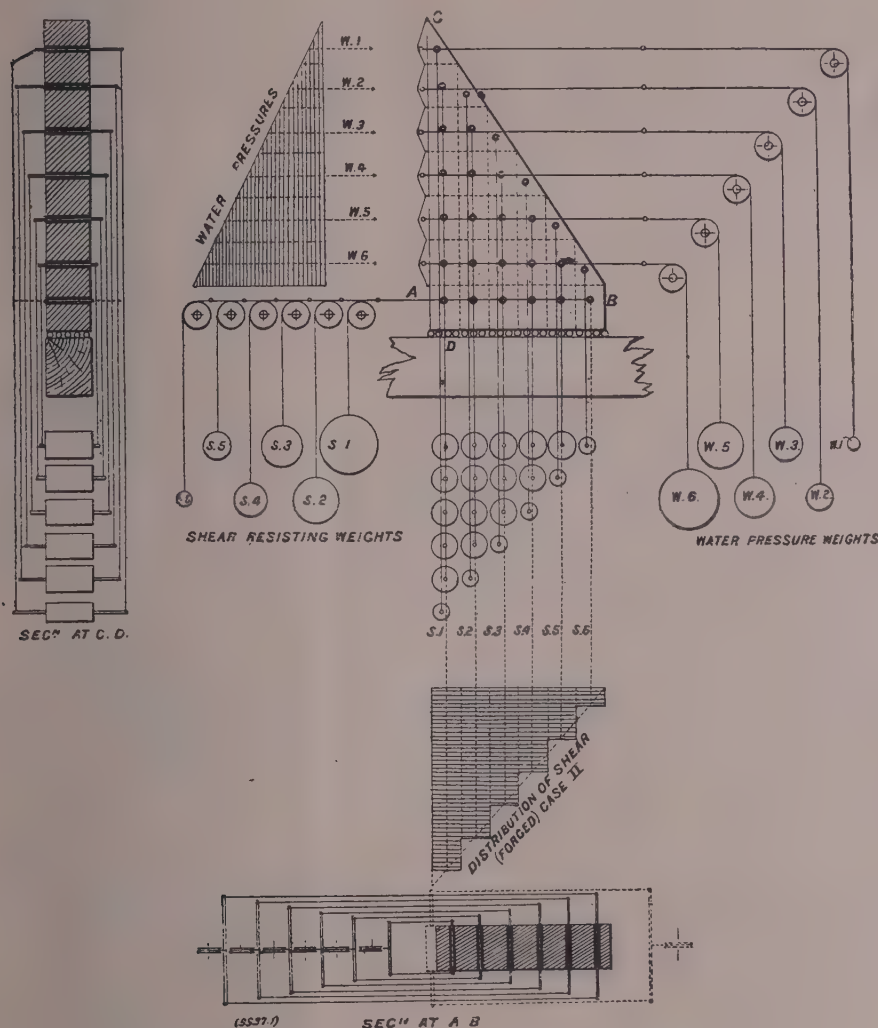


Diagram of Model Dam and Arrangement of Weights.

tained, and that the intensity of shear is a maximum at from one-seventh to one-eighth the length of the section from the down-stream limit, and appears to diminish between that point and the limit.

Case II is obtained by reversing the order of the shear-resisting loads, so that the maximum is at *A*. It is remarkable that, although the forced distribution along *AB*, in Case II, must be approximately triangular with the maximum at *A*, the distribution of shear along the section line immediately above is very different, and that along sections higher up the dam the distribution reverts very nearly to that in Case I. It will be observed, however, that the intensity of shear along the base in Case II has a tendency to rise near the up-stream edge.

The forced distribution of shear in Case III is the same as in Case II, but the up-stream toe of the substratum is held down on the layer of

planes, and horizontal pressures p_2 on vertical planes, are calculated from the strains e_1 and e_2 measured in the corresponding directions.

The curves of vertical pressures in Case I are not linear, and in form they are of the same type as those of the intensity of shear. The maximum values occur at points one-seventh to one-eighth of the length of the section from the down-stream edge. Some tension near the up-stream edge can be detected and is to be expected, as, on account of the distortion, the resultant must be beyond the down-stream middle third. That there is no tension indicated on the lowest section is explained by the fact that the substratum is not artificially loaded and the up-stream toe is not held down. It will be noted that some tension, on the vertical section near the down-stream toe, is measured.

None of the curves here given are carried right up to the limits of the sections. Measurements

system is situated on the banks of the Clyde, where an unfailing supply of water for condensing purposes is available. The Motherwell station of the system being situated at a higher elevation, and above the level of the River Clyde, has to depend for its water supply for condensing purposes on electric pumps working against a head of 140 ft. The two plants at Yoker and Motherwell are, otherwise, very similar in most respects.

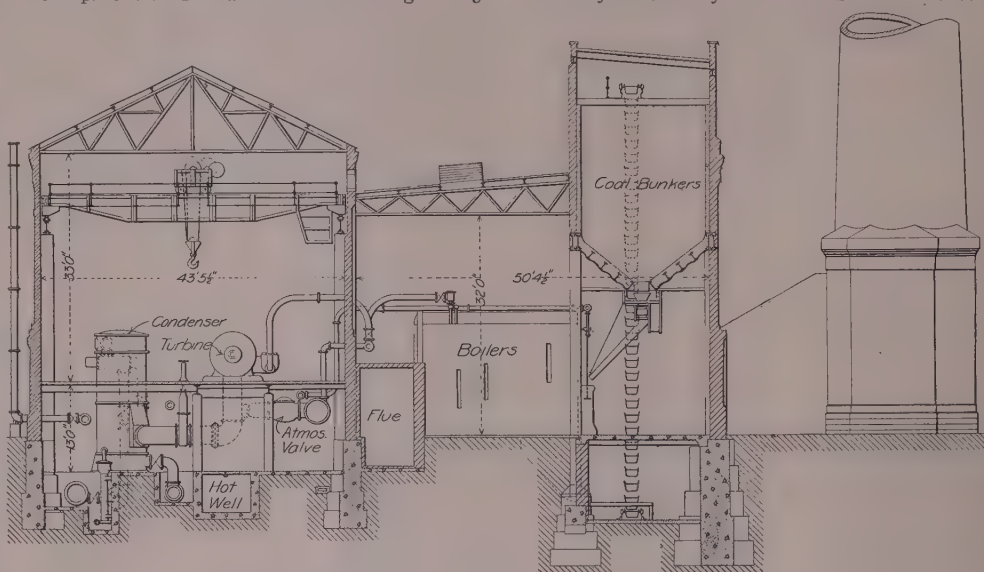
The boiler house of the Yoker station has an internal measurement of 186 ft. long by 50 ft. wide. It is well lighted, and is designed in every way to afford a maximum of convenience. There are at present four double drum Babcock & Wilcox water-tube boilers in position, each having a heating surface of 4,400 sq. ft. and fitted with superheaters capable of imparting 150° F. of superheat. The steam pressure is 175 pounds per square inch. The boilers are connected to a main flue passing along the back, and at the end a Green's economizer of two sections and 432 10-ft. tubes is installed between this flue and the chimney, with the usual bye-pass flue for cutting it out of service when necessary.

The chimney is built of the special perforated and moulded bricks on the Alphons Custodis system, and is 225 ft. high above the foundations, with an internal diameter at the top and bottom of 11 and 14 ft., respectively. It is lined with fire bricks up to a height of 85 ft. above the top of the foundations, which extend to a depth in the ground of 22 ft. The base of the foundations

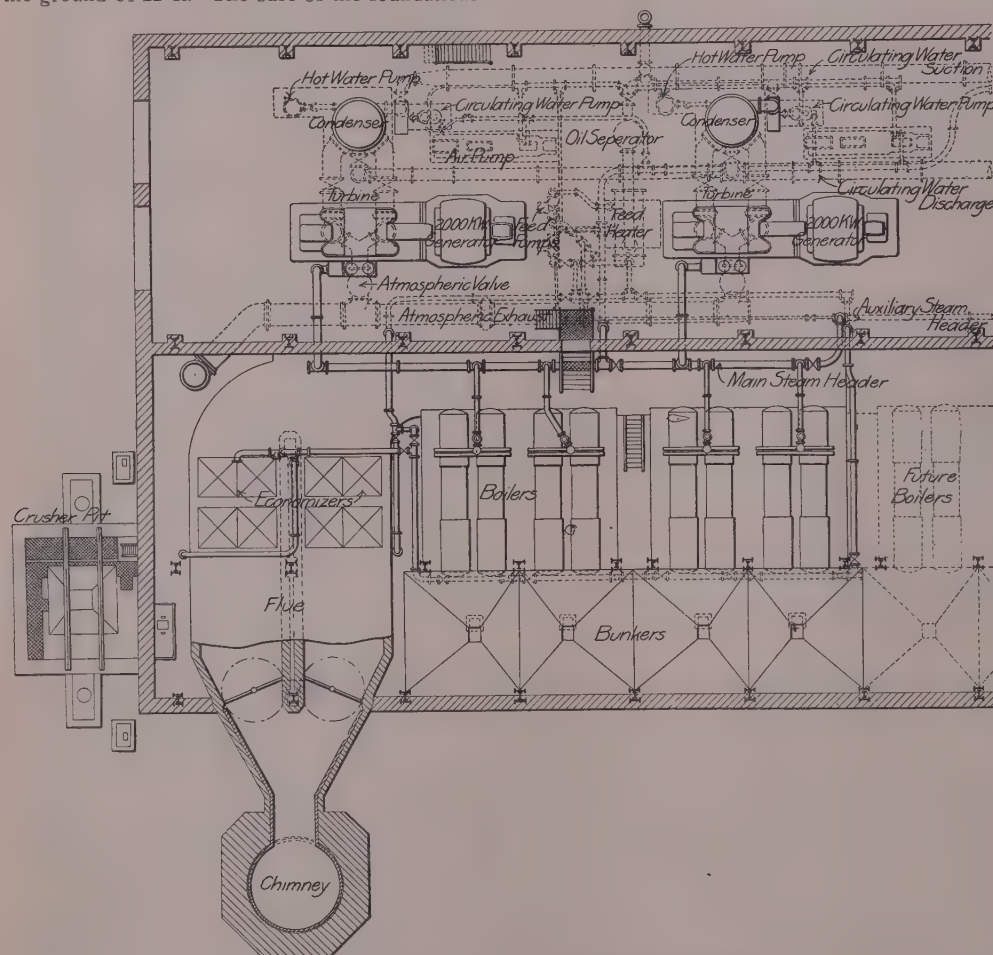
running at 400 r.p.m., and situated in the boiler house. The coaling arrangements of this power station are most complete, and from start to finish the fuel is untouched by hand. Coal is brought in cars to the company's private siding, where it is dumped by hydraulic ram into the crusher pit, passing through a crusher and screen operated by a 10-hp. enclosed shunt motor running at 650

recorded on an indicator. To prevent the coal sticking in the shoots a motor-operated agitator is installed, which keeps it constantly on the move.

The engine room of the Yoker plant consists of two floors, one on the ground level and one in the basement, the latter containing most of the auxiliary machinery. The turbine condensers,



Cross-Section of the Yoker Turbo-Generator Station.



Part Plan, Yoker Station of the Clyde Valley Power System.

occupies a space of 2,116 sq. ft., and the weight divided over the entire area is two tons per square foot, allowance being made for wind pressure.

Each of the boilers is fitted with a Roney mechanical stoker manufactured by the British Westinghouse Company, and adapted for burning efficiently a cheap class of coal. These are driven through special worm gearing by two 4½-in. by 4-in., 5-hp. Westinghouse standard engines,

r.p.m. It is there picked up by a bucket conveyor, constructed by Graham, Morton & Co., and carried to the storage bunkers over the boiler house. This conveyor, which is driven by a 15-hp. enclosed shunt-wound motor, is also used for carrying the ashes away from the boiler house. From the bunkers the coal passes automatically to the stokers, being weighed, also automatically, in transit, and the number of hundred weights used

which are of the Mirrless-Watson vertical surface type, each with 6,250 sq. ft. of cooling surface, are placed here, their upper ends projecting through the main floor a few feet. Each turbine exhausts directly into its own condenser, and each condenser is provided with a steam-driven, two-stage, dry air pump situated in the basement. Arrangements have also been made for exhausting to atmosphere through a back-pressure valve, if necessary.

Circulating water for the condensers is drawn from the Clyde, running by gravity into a large circular well 18 ft. in diameter and of a depth below water level of 9 ft. There are two 30-in. pipes leading into the well from the river, and the water is drawn out through a 36-in., cast-iron pipe by means of a steam-driven centrifugal pump placed in the basement.

After passing through the condensers the water is discharged by a 36-in. pipe into a tank on the bank of the river. The condensed water is pumped into the hotwell, which is also in the basement, by a centrifugal pump driven by a 6-hp., vertical-shaft, shunt-wound motor running at 625 r.p.m. From here it passes to the suction of the two feed pumps, which are of Messrs. J. & P. Hall & Sons' tandem, compound, double-acting type, each capable of delivering 9,600 gallons per hour against a boiler pressure of 175 pounds. The make-up water is taken from the city mains, that of the Clyde being unsuitable for boiler feed purposes; there is, however, a standby suction from the river for use in case of emergency. The exciter sets have their separate surface condenser, which is of the Worthington Pump Co.'s make, and has 600 sq. ft. of cooling surface. In addition to the above auxiliary plant there is installed a feed-water heater by Messrs. Joseph Wright & Co., having a heating surface of 700 sq. ft.

In the upper and principal floor of the engine room the measurements are 252 ft. long by 43 ft. 5½-in. wide. This room is well lighted from the roof, the walls are faced with white glazed bricks, and the floor throughout is paved with Italian mosaic work. At the north end are situated the switchboard galleries and offices, which have an inside measurement of 53 ft. by 43 ft. 1-in. wide. Accommodation is also provided here

for the station superintendent, storekeepers and timekeepers. The offices are separated from the switchboard galleries by iron doors and fireproof partitions, special attention having been paid to the details of fireproofing.

At present the main generating plant installed consists of two Westinghouse-Parsons steam turbine units, each with a normal capacity of 2,000 kilowatts and an overload capacity of 3,000 kilowatts. The speed is 1,500 revolutions a minute, which corresponds to a peripheral velocity of the rotating part of 5 miles a minute. The turbines are of the latest double flow pattern, steam entering at the center and exhausting at both ends, and each contains no less than 20,000 blades. These are securely fixed to the steel drum and are of drop forged steel in the first series and special metal at the low-pressure end so as to prevent corrosion due to the wetness of the steam. The cylinder is of close-grained cast iron and the rotor consists of a rolled steel drum fixed to the shaft by the aid of forged steel umbrella-shaped discs shrunk into the drum and pressed on the shaft.

Each of the turbines is directly connected to a Westinghouse 2,000-kw., 11,000-volt, three-phase, 25-cycle generator of the rotating field type. These are of the standard Westinghouse design. The

nishing the exciting current for both the main generating units at present installed. They are of 75-kw. capacity each, and consist of a Westinghouse 11-in. by 19-in. by 11-in. vertical compound engine, running at 290 r.p.m., coupled direct to a 125-volt, compound-wound dynamo. In addition these exciters supply current for operating the motors of the coal and ash conveyor, crushers, agitators, economizers, pumps, traveling crane, etc., and also for the electrically operated main and other switches.

The traveling crane was furnished by Messrs. G. & A. Musker & Co., and in the case of the Yoker plant has a span of 42 ft. It is of 30 tons capacity, of the three-motor type, these being of the Westinghouse type SB, totally enclosed pattern, series wound. The motors are of the following horse-powers and speeds: Lifting, 25-hp., 460 r.p.m.; longitudinal travel, 10-hp., 650 r.p.m.; transverse travel, 4-hp., 935 r.p.m.

The whole of the switch gear is contained in the three galleries at the south end of the engine room. That on the ground floor and the first gallery consists of the oil switches and feeders, while on the third or top gallery are placed the main bus-bars in brick compartments and the main controlling board, as well as the resistances, etc. Following the latest practice, the

27.5 in. when dealing continuously with 80,000 pounds of exhaust steam per hour, if supplied with 348,000 gal. of circulating water per hour at a temperature of 80° F. In connection with this condenser there are installed at Motherwell two Alberger-Corliss two-stage dry vacuum pumps, one of which is capable of dealing satisfactorily with the air in the condenser when one turbine only is in operation. The dimensions of these pumps are as follows: Diameter of steam cylinder, 10 in.; diameter of air cylinder, 24 in.; stroke, 24 in. Their normal speed is 100 r.p.m., but they are capable of working at a lower rate if necessary. The steam and exhaust valves are of the Corliss type, and special features of design have been introduced in the valve gear so as to adapt it to high speed operation without noise or jar in case of emergency, such as serious leakage of the exhaust piping or condenser connections, or other partial loss of vacuum.

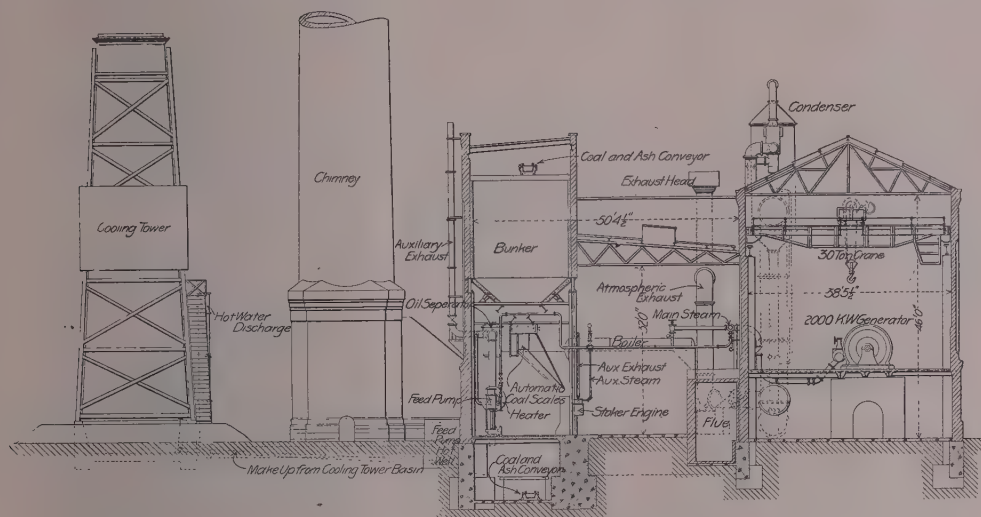
Six feeders are provided for distribution from Yoker, and all are protected where they enter the building in the basement by Westinghouse lightning arresters. The cables for supplying power to any part of the district between Clydebank and Scotstoun, as well as to Temple, are practically finished. They are all laid in duplicate, so that in case of any accident happening to one of them the spare one can be connected immediately, while the duplicate is being repaired.

As previously stated, the Clyde Valley Electrical Power Company is authorized to supply in the adjacent Burgh of Clydebank. For this purpose special plant has been installed at Yoker consisting of two 150-kw motor-generator sets, each of which is provided with a small motor coupled direct to the shaft, which serves for starting and running up to speed. The motor-generators are situated in the first switch gallery of the Yoker power station and the switchboard controlling the distribution to this area is placed on the top gallery.

Both the high and low-tension cables for the Clydebank district were supplied and laid by Messrs. Henley & Co., and the British Insulated Wire Company has been entrusted with the extra high-tension cable work throughout the entire area. The number of sub-stations at present installed in the layout of the scheme is ten for the Motherwell district and two for Yoker.

The general arrangement of the entire plant was designed by Strain & Robertson, consulting engineers, of Glasgow. Mr. H. A. Barnett, resident engineer to the Clyde Valley Company, has had the supervision of the erection and installation of both power stations and the distribution system since the commencement. The data here given are due to the above-mentioned gentlemen and to Mr. D. A. Starr, general manager of the Clyde Valley Company, who has also kindly furnished assistance in the preparation of this description.

VERY HIGH PIERS have been built for a single-track railway bridge over the Sioule River near Vauriat, France. This structure has a central span of 472 ft. and two side spans of 378 ft. Each pier is 302.8 ft. high above the base, which is 10.7 ft. deep and 42 x 77.4 ft. in plan. Just under the corbel at the top each pier is 36 x 18 ft. These slender columns have their faces curved instead of being on a straight batter, and are hollow inside, the opening being about 6.5 x 29.6 ft. at the bottom and 6.5 x 13.5 ft. at the top, 26 ft. below the bridge seat. Granite rubble in hydraulic lime mortar was used for the interior and dressed granite in Portland cement mortar for the face work. The lattice girders carried by these piers form a single continuous truss from abutment to abutment, which is fixed at one pier and is supported elsewhere by expansion bearings.



Cross-Section of the Plant at Motherwell.

two-pole field magnets consist of a solid forging of Whitworth fluid-pressed steel combining high magnetic properties with strength, and the armature, of laminated iron wound with copper bars in practically closed slots, is supported by a heavy cast-iron frame divided horizontally. The starting, stopping and speed variations of the generators are under control from the switchboards by electrical means, current for this purpose being taken from the exciters.

The oiling of the turbines is carried out on the gravity system. A large tank in the basement of the engine room receives the oil overflowing from the bearings, which is then passed through coolers and raised by a special oil pump to a tank in the roof of the boiler house, flowing from thence by gravity under a head of 50 ft. back to the bearings. Oil pressure gauges are provided on the latter in order to indicate at a glance how the apparatus is working.

The engine room as at present constructed will accommodate one more 2,000-kw. set and a fourth unit of 3,500-kw., which will eventually make the total capacity of the station 9,500-kw. The additional sets will be added as soon as one of the present units is loaded up, so that there will be always one spare ready at any moment in case of accident.

The two exciter sets, situated at the south end of the engine room, are each capable of fur-

control board consists of a small desk directly facing the various instruments such as ammeters, voltmeters, power factor indicators, relays, etc. All the main switches and smaller gear are electrically operated from this desk by the exciter current as before mentioned, and from here the speed of the turbo-generators and their starting and stopping is also controlled.

The Yoker and Motherwell power stations are, as already noted, of the same size and almost identical in arrangement, so that the foregoing description applies generally to both, with the following exceptions: The Motherwell station is not so favorably placed as Yoker, being 400 yards from and 140 ft. above the level of the river. A cooling tower of Balcke make has, therefore, been installed for cooling the circulating water. It is of the natural draught, enclosed type, 73 ft. high, and is constructed entirely of wood thoroughly soaked in carbolineum of the best quality. The tower has a normal capacity for cooling 220,000 gallons of water per hour from 120° F. to 80° F. when the temperature of the air is 70° F. or less; and the amount evaporated under ordinary conditions of atmospheric temperature does not exceed 2½ per cent of the water circulated.

Another of the features in which the Motherwell station differs from Yoker is in the condensing plant, a barometric jet condenser having been installed. This is capable of giving a vacuum of

The Scioto River Storage Dam at Columbus Ohio.

By John H. Gregory.

The water works of the city of Columbus were first put in operation on May 1, 1871, the supply being derived from a well 20 ft. in diameter, and a brick filtering gallery 256 ft. in length, situated on the east bank of the Olentangy River, near its junction with the Scioto River, adjacent to which was built what is now known as the West Side Pumping Station.

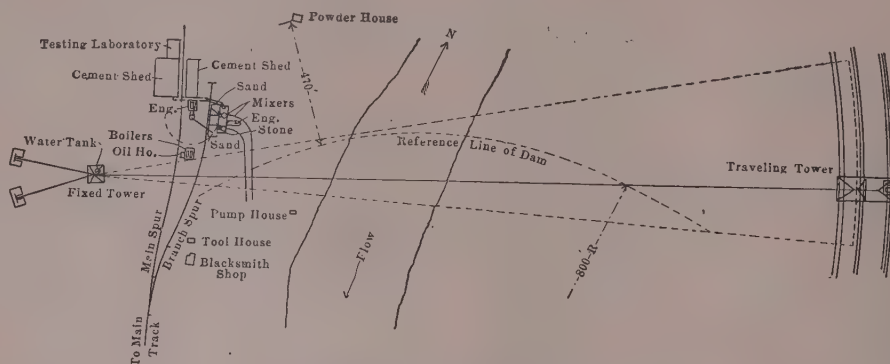
The ground water source of supply then adopted is still used, extensions of the filtering gallery or conduit system having been made under and along the Olentangy and Scioto Rivers, until a total length of 13,097 ft. of brick and iron conduit, 42 in. in diameter, was provided. Notwithstanding this extensive increase in the system, the supply of water has been inadequate for the growing city, so that every year since the works were first established, more or less water has been obtained, by a direct intake from the Olentangy and Scioto Rivers.

In 1889 the Water Works Trustees, being of the opinion that the filtering gallery or conduit system, as developed in the Scioto Valley, had been exploited to as great an extent as was profitable, turned their attention to the valley on the east side of the city, and as a result, the Alum Creek, or East Side Pumping Station, was constructed. Pumping was begun May 5, 1891, from a brick well, 25 ft. in diameter and from 32 tubular wells, 6 in. in diameter and from 60 to 65 ft. in depth.

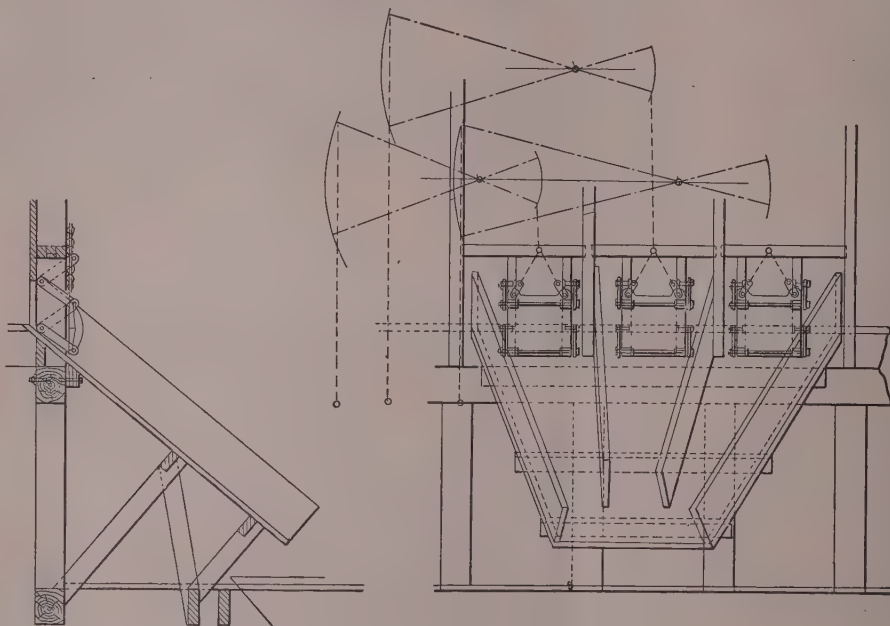
A more recent extension of the conduit system at the West Side Station was made in 1897 and 1898, whereby 3,000 ft. of 42-in. cast-iron pipe were laid. This was undertaken as a precautionary measure, to provide a duplicate system for use in case of failure of the old brick conduit. Warning that a collapse was liable to occur had several times been given by the caving in of this conduit at sundry points near the upper end. At the time the new iron conduit was built, 37 tubular wells, 6 in. in diameter, were sunk along its line at depths varying from 20 to 58 ft. below the

17,000,000 gallons being pumped from the West Side Pumping Station. No distribution reservoirs or standpipes have ever been provided, reservoirs having been out of the question on ac-

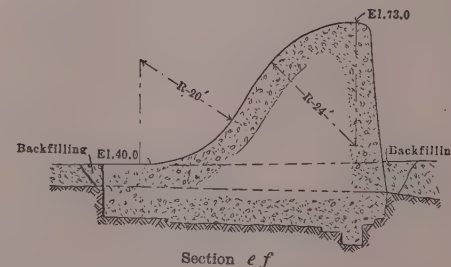
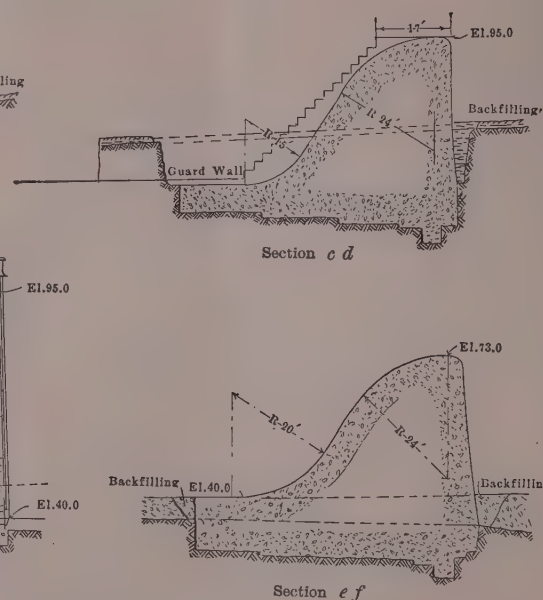
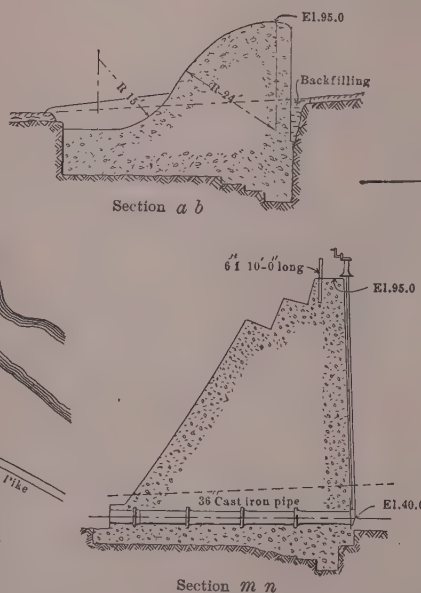
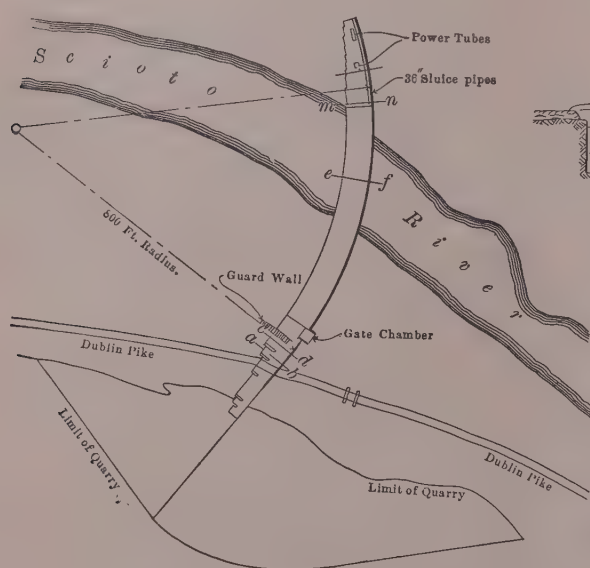
Griggs reported early in 1898, in favor of constructing a curved concrete overflow dam 30 ft. high across the Scioto River, about $5\frac{1}{2}$ miles northwest of the West Side Pumping Station,



Arrangement of Contractors' Plant.



Gates and Spout from Bins to Hopper.



Plan and Sections of Dam across the Scioto River.

bottom of the conduit. Most of these wells, at the time they were drilled, were flowing wells at the conduit elevation.

The city is, at present, supplied by direct pumping service from the two pumping stations, three-fourths of the total daily consumption of about

count of the topography of the city and the surrounding country.

In 1897, the problem of obtaining an additional water supply was studied by Mr. Julian Griggs, Chief Engineer of the Department of Public Improvements. As a result of his investigations Mr.

whereby an impounding reservoir of adequate capacity could be obtained.

In the spring of the same year, general plans of the proposed improvement were submitted to the Ohio State Board of Health, and in their approval a recommendation was made that the

height of the dam be increased from 30 to 50 ft., thereby providing a much greater storage capacity.

In June, 1898, Mr. James D. Schuyler was asked to review the whole subject, and in a report made in July, 1898, he endorsed the proposed construction and concurred in the recommendation that the 50-ft. dam be built. Several attempts were made in the course of the next two years to begin construction work, but owing to legal and other difficulties they were unsuccessful.

In 1900, the question of an additional supply was again taken up and Mr. Samuel M. Gray was asked to report not only on the additional supply, but on the improvement and extension of the whole water-works system. In his report, made in February, 1901, Mr. Gray not only endorsed the previous recommendations that the Scioto River be adopted as a source of supply by building a high masonry dam across the river and an impounding reservoir, but advised also that a water-purification works, consisting of a softening and mechanical filtration plant, be built adjacent to the present West Side Pumping Station; that a gravity conduit be laid from the reservoir to the water-purification works; that the

where further study has indicated that it would be desirable. It is the purpose in the present article to describe the dam and reservoir which are now under construction and in a subsequent article certain other features which will be of interest.

The Scioto River storage dam, as it is officially known, is being built of cyclopean masonry, that is, of Portland cement concrete in which stones as large as can conveniently be handled are bedded. A general plan of the structure is shown in one of the accompanying cuts, and, as will be seen, the dam is of the curved or arch type with the convex side upstream, the vertical part of the upstream face of the dam being built to a radius of 800 ft. The dam, although of the curved or arched type, has a gravity section, as shown in the other cuts. The total length of the dam will be about 1,000 ft.

The overflow, which will be in the center of the dam, will be 500 ft. in length and will have a roadway section with an apron at the toe extending a short distance down stream. The crest of the overflow will be 30 ft. above mean low water in the river and will be about 46 ft. above the foundation. The abutments on each side of

In the abutment sections at each end of the overflow four lines, and in the overflow section two lines of 60-lb. steel rails will be embedded. On the abutment sections and also on the future overflow section wrought-iron pipe railings will be placed. The posts of the railings on the downstream side of the abutment sections will consist of 7-in. 20-lb. I-beams, 10 ft. long, and bedded about 7 ft. into the concrete. These posts will be spaced 5 ft. on centers and will assist in bonding the new work to the old should the dam be raised. At the overflow section a certain amount of cutting away of the old masonry will be required to make a satisfactory bond with the new.

With the 52-ft. dam it would be possible for several months of the year to develop a considerable amount of water power from the water which would flow over the dam in excess of the amount required by the city, and in the event that it should be found advisable to develop this power, provision is being made for so doing by building in the present work three so-called power tubes for connecting with the future penstocks. Each tube will be 9 ft. in diameter and will consist of riveted steel pipe 5/16 in. thick, reinforced with stiffening angles around each section of the pipe. For the present a reinforced concrete bulkhead will be built in each end of each tube, and on the upstream ends heavy flanges will be provided to which screens or gate frames can be bolted.

Just west of the overflow are located six 36-in. circular sluice gates, made by the Michigan Brass & Iron Works, of Detroit, with cast-iron pipes extending through the dam and intended only for carrying the ordinary flow of the river during the period of construction. On the completion of the work these gates will be closed and not used except in case of emergency or in case it should be found necessary for some unforeseen cause to drain the reservoir to the lowest possible point.

The gate house and gate chamber will be located just east of the overflow and will for the present be reached from the east bank by walking over that portion of the dam which will be the future overflow. Should the dam be raised the gate house will be reached from the west bank by walking over the main portion of the dam. Owing to the great length of the overflow, 500 ft., and to the depth of water overflowing during periods of extreme high water, it was not considered advisable to bridge the overflow or to make provision for bridging the future overflow.

In the present construction no superstructure for the gate house will be built, the gate house being included in the upper part of the gate chamber, with its roof flush with the top of the dam. The floor of the gate house will be 11 ft. above the crest of the overflow and at a height sufficient to prevent flooding except in case of extremely high water. Access to the gate house will be had through a large manhole in the roof and a steel ladder extending to the floor below. The manhole will be fitted with a lock cover and all arranged to readily shed water.

Water will be admitted to the gate chamber through the openings in the upstream face. The chambers are arranged in duplicate, so that should it be necessary to get at any of the sluice gates in one set of chambers the supply can be kept up through the other set. In each of the upstream chambers are two 36-in. by 60-in. rectangular sluice gates, and in each of the downstream chambers one 48-in. circular sluice gate with a cast-iron pipe extending through the dam. These sluice gates were made by the Coffin Valve Co., of Boston. Three sets of grooves have been provided in each of the upstream chambers, the two outer ones for stop planks and the inner one for screens.



View of the Work on the West Bank of the River.

East and West Side Pumping Stations be abandoned; that a new pumping station with an entirely new equipment be built, and that the distribution system be revised and reinforced.

Subsequent to the presentation of Mr. Gray's report steps were taken to inaugurate the construction of the work outlined and recommended by him, but it was not until early in 1904 that all obstacles were removed. In February the City Council appropriated \$550,000 for the construction of the dam and reservoir, and in November the people by popular vote authorized a bond issue of \$1,200,000 for the construction of the water-purification works, pumping station and certain other works necessary for the improvement of the water supply. No appropriation has yet been made for the gravity conduit and until such appropriation is made it will be necessary to use the river as a conduit from the dam to the purification works and pump the river water by means of low-lift pumps into the settling basins of the purification works.

In the development of the improvement and extension of the water supply the general scheme outlined in Mr. Gray's report is being followed, but modifications in the details are being made

the overflow will be carried up 22 ft. above the crest of the overflow. The overflow was designed for carrying a maximum rainfall of 6 in. flowing off in 24 hours from a drainage area of about 1,032 square miles, or about 166,500 cu. ft. per second. On a weir 500 ft. long this would correspond to a depth of about 21.7 ft. The greatest recorded flood, March, 1898, gave a computed discharge of about 50,000 cu. ft. per second, which would require a head of about 10 ft. on a weir 500 ft. long.

In Mr. Gray's report it was recommended that a 52-ft. dam be built, that is that the crest of the overflow be located 52 ft. above mean low water, but for various reasons it was considered advisable for the present to build only the 30-ft. dam. Provision is however being made by building the present work to the section of the 52-ft. dam, so that the dam can subsequently be raised 22 ft. This accounts for the peculiar looking section and the stepping off near the top for bonding with the future work. Should the dam be raised at a later date the future overflow will be located at one end of the dam east of the gate house, and this part of the dam is being built with that end in view.

With the present or 30-ft. dam no screens will be installed as it is intended to use the river as a conduit to the purification works below until the gravity conduit is built, as previously stated. Under conditions which will exist after the completion of the dam, with the reservoir full and the flow of the river in excess of the amount pumped out at the purification works, the entire flow of the river will pass over the overflow. When the flow is less than the amount pumped out below, the water will be drawn off through the sluice gates and the deficiency made up from storage.

The present gate chamber has been designed so that should the dam be raised the 22 ft. at a later date, no changes will be required other than to build the gate chamber up to the required height, to extend the stems of the sluice gates and to take up the floor and place it at the new elevation. With the 52-ft. dam two additional 36-in. by 60-in. sluice gates will be added between the up-stream and down-stream chambers, and in the event of the building of the gravity conduit the screens will also be added.

The foundation on which the dam is being built is of limestone. Preliminary borings, made on and adjacent to the site of the dam, with one exception, indicated that the character of the rock would be satisfactory. In the lower part of the work as far as revealed the rock has been hard, sound and free from clay pockets and has been all that could be desired. On the east and west banks at a higher elevation the rock was softer and some fissures filled with clay were found. The excavation was, therefore, carried to a greater depth and further into the bank than was originally anticipated and until an acceptable foundation was obtained.

Under the up-stream portion of the dam a cut-off trench about 5½ ft. wide and from 3 to 5 ft. deep has been excavated. During the season of 1904 a drill mounted on a horizontal bar was used

factory results. Light charges of power have been necessary, however, to loosen the rock, but shattering of the sides of the trench and the excavation has been avoided.

The work of excavating and laying concrete has been protected by two cofferdams, one built out from each side of the river. The first cofferdam was constructed last season out from the west bank to the middle of the river and the masonry laid in it to a point above low water.

tions of one volume of cement, three volumes of sand and six volumes of ballast.

Lehigh Portland cement is furnished to the contractor by the city. The cement is delivered in cloth bags in carload lots on a public siding on the west bank of the river, about three-quarters of a mile from the site of the dam, but the contractor transports it to the cement sheds, unloads it and handles it into the work.

The ballast consists of broken limestone, the



Concrete Plant used on the Construction of the Scioto Dam.



General View of the Dam during Construction.

for drilling holes along each side of the cut-off trench and the main excavation and light charges of powder were used to loosen the rock. Although great care was taken in blasting, this method was not satisfactory, as after the removal of the rock the sides of the trench and the excavation were found to be slightly shattered. This season a channeling machine, made by the Ingersoll-Sergeant Drill Co., has been used with satis-

This season the second cofferdam has been extended out from the east bank to join with the work already built, and the first cofferdam removed. The flow of the river is at present taken care of by the 36-in. sluice gates, supplemented by a discharge over a low section of the dam.

The concrete which is being used in the main body of the dam and in which stones are embedded, is mixed approximately in the propor-

specifications requiring that it be broken and screened into three sizes, as follows: No. 1, ½-in. to ¾-in.; No. 2, ¾-in. to 1½ in.; No. 3, 1½ in. to 3 in.

The six volumes of ballast in the concrete are made up from the three sizes, mixed in such proportions as the engineer shall require. In general these proportions have been about eight parts of No. 1 ballast, seven parts of No. 2 ballast, and seven parts of No. 3 ballast.

The original specifications required that the contractor should open a quarry and excavate the stone and ballast for use in the dam from this quarry. The quarry is located at the east end of the dam on the site of what will be the future overflow, the intention being to excavate for the future overflow under the present contract. After the work was started the contractor thought it would be to his advantage if he could be allowed to obtain stone from another quarry off the site of the work a short distance below the dam. The specifications were modified to allow him to obtain the stone, so long as it was of suitable quality, from such point as he desired, but the city's interest has been protected by his being required to excavate two-thirds of a cubic yard of rock measured in place from the quarry site for every cubic yard of ballast used in the dam. In accordance with the modification made the contractor is obtaining ballast from this other quarry, but the stone bedded in the concrete has so far been obtained from the excavation on the site of the work.

For the exposed face of the overflow on the top and down-stream side of the dam the concrete is composed of a richer mixture; one volume of cement, two volumes of sand and four volumes of ballast. This richer concrete is placed at the same time as the other concrete and so that there-

will be no joint between it and the concrete in the interior of the dam.

On one of the accompanying drawings the general arrangement of the contractor's plant is shown. A spur has been built from the public siding above mentioned, over which materials are delivered. The spur is located on the high ground at the west end of the dam. The cement sheds are on the same level as the track, one on either side of the main spur. The storage bins for the sand and ballast are located adjacent to a short branch spur leading from the main spur and at a lower elevation. The bins are five in number, the two end ones containing sand, those next adjacent the No. 1 ballast, and the center one a mixture of the No. 2 and No. 3 ballast. The ballast is discharged directly from the cars, but the sand is handled by a derrick and clam-shell bucket.

The concrete is mixed in two 5-ft. cubical box mixers, made by Kaltenbach & Griess, of Cleveland. The charging hoppers are conical in form and are located directly above the mixers,* the tops of the hoppers being flush with the mixing platform. The sand and ballast is discharged through chutes into the charging hoppers which are also used for measuring the proportions. The two storage bins at one end feed into one hopper,

which the concrete is dumped. These skips have not been found to be very satisfactory and are now being replaced by bottom-dumping buckets, made by the G. L. Stuebner Iron Works, of Long Island City.

In the earlier stages of the work the cable was used mainly for moving the excavated material. At present it is so used when concrete is not being handled, but is supplemented by several stiff-leg and guy derricks.

The cement-testing laboratory is located adjacent to the cement sheds and in it the city has provided a very complete equipment for testing and making chemical analyses of the cement.

The reservoir, formed by the construction of the dam, is peculiar in shape in that it is extremely long and narrow, having a length of about 6.1 miles and a mean surface width of about 490 ft. The total capacity up to the elevation of the crest of the overflow will be about 1,627,000,000 gallons, and the surface area at the same elevation will be about 363 acres. Should the dam be raised 22 ft. the reservoir will have a capacity of about 5,681,000,000 gallons, with a surface area of about 775 acres.

Inasmuch as the water stored in the reservoir is to be purified by filtration, the reservoir has not been stripped. All trees and brush have been

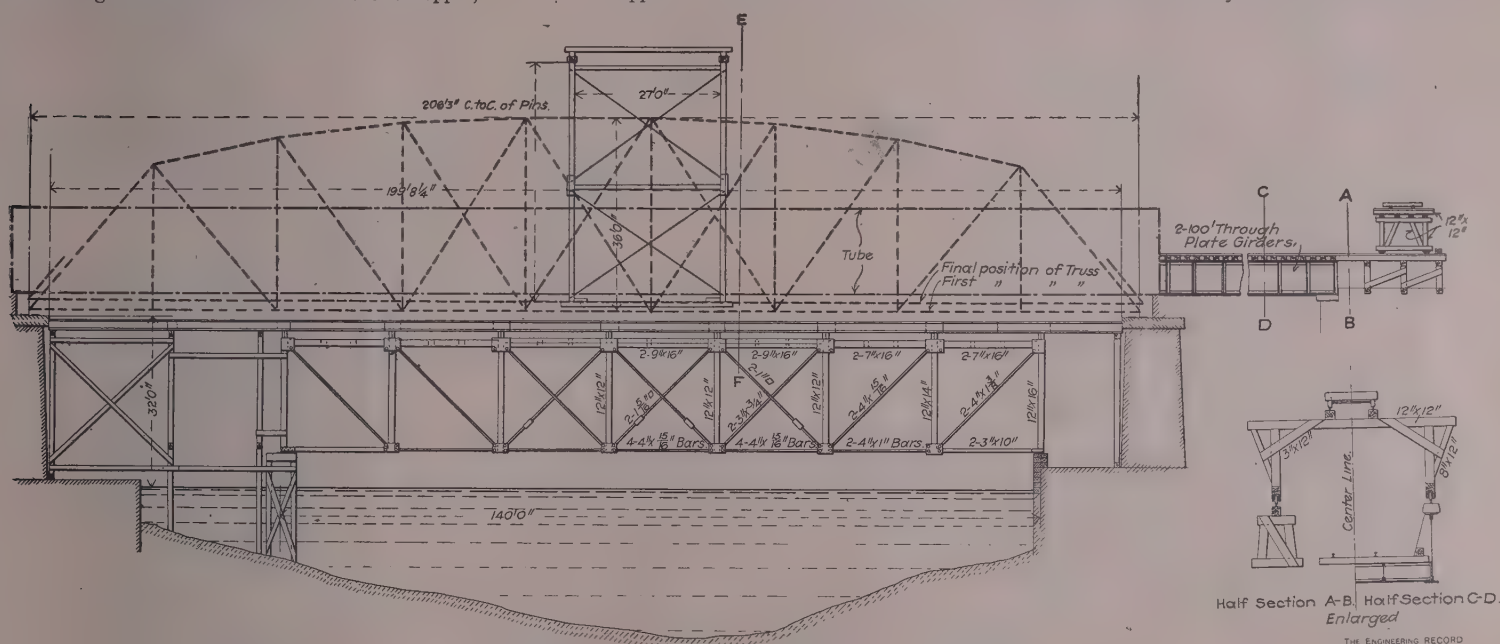
Island Lime & Transport Co., of Cleveland, at \$1.70 per barrel, with a rebate of 40 cts. per bbl. for cloth bags returned.

The contract for grubbing and clearing the reservoir was let to Hoover & Kinnear, of Columbus, at \$70 per acre.

The work of the improvement and extension of the water supply is under the direction of the Board of Public Service, Mr. Hiram O. Pond, President. Mr. Julian Griggs is Chief Engineer, the writer is Principal Assistant Engineer, and Mr. F. B. Edwards is Resident Engineer, in charge of the construction of the dam and reservoir. The inspection and testing of cement is under the direction of Prof. A. V. Bleininger, of the Ohio State University. Mr. Jerry O'Shaughnessy is superintendent of the water works and the maintenance and operation of the works when completed will be in his charge.

The Erection of the St. Anne's Bridge.

The original Grand Trunk R. R. bridge at St. Anne's, Canada, was one of the very few tubular wrought-iron bridges built in America. It was a single track through structure about 212 ft. long, 16½ ft. wide, and 15 ft. high in the clear, inside. After several years' service it became in-



Falsework Truss and Traveler for Replacing Tubular Span.

and the two binds at the other end into the other hopper. The center bin is arranged to discharge into both hoppers. The cement is delivered in bags from the cement sheds above through a winding chute onto the mixing platform. The concrete is mixed very wet, one batch consisting of about 1¼ cu. yds.

From the mixers the concrete is discharged into skips resting on small flat-bottom cars, which are hauled away from the mixers by horse power. For transporting the concrete out into the work a cable is used, supported by a fixed tower 75 ft. high on the west bank of the river and by a traveling tower 95 ft. high, moving on the arc of a circle on the east bank. The cable has a span of 1,380 ft., and the arc on which the traveling tower moves, 400 ft., is of sufficient length to allow all points of the dam to be reached.

The operations of moving the traveling tower, and of transporting, lowering and dumping the skips are controlled by the engineer on the traveling tower in response to a code of electric bell signals sent by a signalman located opposite the point where the concrete is being deposited.

The skips which have been used for handling the concrete are 7 ft. square and 2 ft. deep, arranged with a swinging door at one end through

cut down and all stumps and roots one inch or more in diameter have been grubbed out to a depth of at least 1 ft. below the surface of the ground. All material which has been removed by clearing and grubbing has been burned and at a later date the whole surface of the ground will be burnt over. Two frame houses, three frame barns and one brick school house have been moved from the site of the reservoir, two dwellings have been burned down and several barns have been torn down and the material removed.

The main contract for the dam was let in May, 1904, to James Westwater, of Columbus, at the following prices: Dry earth excavation, 40 cts. per cu. yd.; wet earth excavation, 80 cts.; rock excavation, \$1.50; concrete, \$3.95.

The contract price for the concrete does not include furnishing the cement, but includes transportation from the public siding, unloading, storing and handling the cement into the work; it also includes stripping, opening and excavating the stone from the quarry. The total amount of masonry in the dam was estimated at 52,800 cu. yds., but this quantity will be exceeded on account of deeper excavation. Up to the present time about 24,400 cu. yds. have been laid.

The Lehigh cement is furnished by the Kelley

adequate for the increased traffic, weight and speed of trains and was replaced by a double-track through Pratt truss pin-connected span of about 206 ft. on nearly the same center line and grade. The erection, which did not interrupt traffic or obstruct the river, was accomplished by the use of temporary falsework combination trusses of special design and by moving the old tube and new trusses horizontally and vertically during the successive stages of the work.

Framed falsework bents were set up on shore under both ends of the old tube and a framed timber tower was built in the water about 14 ft. deep, about 45 ft. from one end, and all of its posts were protected against cutting by heavy ice by spiking old rails on them. One end of each falsework truss was supported on this tower and the opposite end on shore, and at each panel point three 15-in. transverse I-beams were set on the top chords to support the pairs of 24-in. I-beams, in 24-ft. lengths, corresponding with the panel lengths, which were placed in the planes of the trusses to make traveler runways extending past the ends of the trusses on the falsework bents to the abutments.

An ordinary gantry traveler was erected on the falsework trusses clearing the tube and the

new trusses, and a track was laid on the top of the tube to deliver material for the new trusses. As a 100-ft. through plate girder approach span intervened between the end of the tube and the storage yard, material cars were taken from the loading derrick at the end of the approach to the end of the tube on a transfer tower with a top track for the material car at the level of the top of the tube. The tower had the masonry clearance over the track to allow the traffic to be undisturbed and moved on single rails on the top flanges of the girders and on pony bents each side of the track between the approach span and the derrick.

The new trusses were erected about $1\frac{1}{2}$ ft. below their required positions and about 26 in. eccentric, laterally. After they were swung, the tube was jacked up 17 in. by a pair of 160-ton hydraulic jacks placed under each end successively. The traffic was still maintained through it while the new floor system was assembled in the space provided beneath it. The tube was blocked up from the new floor and was removed, then the new trusses were moved transversely on well greased horizontal abutment plates, the ends were successively jacked up to position and the final connections there made.

The falsework trusses were proportioned to carry their own weight, the weight of the traveler and its loads, imposing a maximum live load on each of two panel points of each truss; the weight of both new trusses with top lateral and sway braces, but not the weight of the new floor system, or the weight of the old tube. They were made of timber compression pieces stressed to a maximum of 1,000 lb. per sq. in. and steel eyebars stressed at 20,000 lb. per sq. in. The connections at panel points were made with pairs of steel plates having riveted and reinforced diaphragms to receive the post and chord ends, and had separate pins for each tension member, as indicated in the typical connection details. The trusses were completely assembled and connected in vertical planes, in the material yard, where they were handled by the loading derrick. They were suspended by tackles from horizontal transverse timbers supported on a pair of flat cars on the material track, and the trusses were moved out like a pair of saddlebags, one on each side of the tube, and lowered to place by slackening off the tackles which held them secure until the transverse bracing was assembled under the tube. The new work was designed and executed under the direction of the engineering department of the Grand Trunk R. R., Mr. Joseph Hobson, chief engineer. The new span was built and erected in the manner above described by the Pennsylvania Steel Co. Mr. J. V. W. Reynders, superintendent of the bridge and construction department, and Mr. F. W. Cohen, engineer of erection.

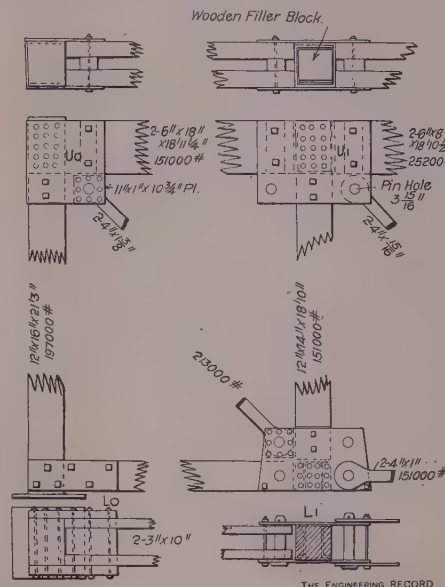
Book Notes.

The measurement of lumber is greatly facilitated by tables, and contractors will accordingly find much help in "Handy Lumber Tables," published at 10 cents by the Industrial Publication Co., New York. They include tables of board measure, of scantlings reduced to board measure, plank measure, and several smaller tables concerning lumber.

Some years ago mention was made in these "Notes" of the appearance of the first part of a "Primer of Forestry," by Mr. Gifford Pinchot, forester of the Department of Agriculture. The second part, devoted to practical forestry, has just appeared, and will be found as interesting and even more instructive than the first. It describes the work that is necessary in taking proper care of a forest, the methods of conservative lumbering and planting, the influence of the weather and

the streams on forest growth, and the practice of forestry at home and abroad. The author, who is in the first rank of forestry specialists, has taken plenty of time in preparing his book, and consequently it is free from the padding and inaccurate statements that are characteristic of hurried authorship. The illustrations are particularly well selected to explain the author's statements by actual photographic reproduction of typical conditions. They have been gathered from many countries and are admirably chosen for educational purposes. The book is issued by the Bureau of Forestry.

A newcomer among trade lists is the "Western Electrical Directory" of the Blanchfield Publishing Co., Rialto Bldg., San Francisco. It gives the names of companies or individuals operating electric light and power plants and electric railways, and the names of absorbed companies, in Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, Hawaii, British Columbia, Yukon Ter., Alberta, Saskatchewan, Assiniboia and a portion of Mexico. The book gives the capital stock and bonds, names of officers, superintendents, purchas-



Elevation and Details of Traveler for St. Anne's Bridge.

ing agents, electrical engineers, location of generating and sub-stations, location of main offices, mileage and number of cars operated by railway companies, electrical contractors and supply dealers, and consulting and contracting engineers.

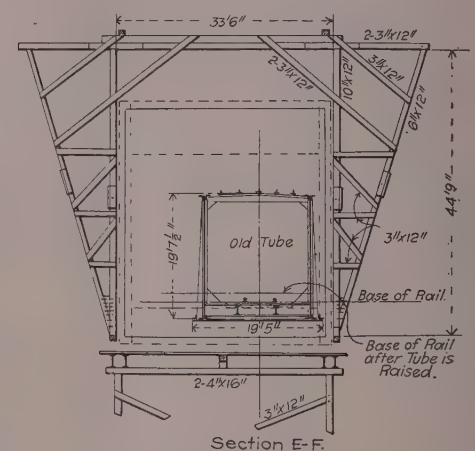
WIRELESS TELEGRAPHY. Its History, Theory and Practice. By A. Frederick Collins. New York, McGraw Publishing Co.; cloth, 8vo., 310 pp., \$3.00.

To the average engineer wireless telegraphy is a mystery. In a general way he knows that it is based on etheric waves, which are associated with some elusive and perplexing conceptions of his college studies. This is unfortunate, for the ether is the fairy-land of science and beautiful indeed to those who will search into its wonderful secrets as a pleasure rather than a task. Just at present, wireless telegraphy seems to be, according to the newspapers, mainly interesting as a means of enabling poolrooms to evade the anti-gambling laws, but soberly considered it affords a demonstration of the practical results that follow the study of a subject so apparently impractical as that of the ether. The intimate connection of wireless telegraphy and etheric phenomena accordingly makes the examination of the new art a study of this wonderful branch of physics as well, and well worth the time of anybody in consequence.

Unfortunately for most engineers, the general

subject of the ether has never been explained so that it is comprehensible with the very limited accurate knowledge of physics and mathematics taught in technical colleges. It is commonly understood to be an immaterial jelly or a sort of glorified superheated steam. In order to comprehend what is being done with wireless telegraphy it is first necessary to have a fair comprehension of the ether, and this Mr. Collins imparts in the first part of the book. It is worth reading not only for the information it contains but also for the delightful way in which it is written. Not for many months has anything so attractive appeared as technical literature, and the book in this respect presents a striking contrast to the dreary dullness of most technical literature.

After explaining the function and constants of the ether and wave motions, the author discusses electric waves, disruptive discharges and electric oscillations in a manner that leaves nothing to be desired, except, possibly, by a mathematical crank. This clears the ground for an explanation of the theory of oscillators, upon which the transmitting apparatus of wireless telegraphy primarily depends. Capacity, inductance, resistance and mutual induction have to be considered in designing such apparatus, however, and the author devotes two chapters to them. The reader is now in a position to understand one part of the problems of the designer of wireless telegraphic apparatus, and the author accordingly explains the



construction of induction coils, interruptors and oscillating current generators.

At this point the author describes the action of electric waves in producing cohesion of material particles. Both the theoretical and experimental aspects of this interesting property are explained as a preparation for a very interesting chapter on electric wave detectors. Then follow chapters on transmitters, receptors, subsidiary apparatus, and aerial wires and earths, dealing with the practical side of wireless telegraphy. Two more chapters on resonance and syntonization explain the limitations of the new art, and the problems facing those developing it. Finally, there is a chapter on wireless telephony.

The book is complete in itself, which commends it to the average reader. All the physical conceptions and laws on which wireless telegraphy depend are explained. Their history is told with a careful weighing of the relative importance of the several steps in the development of our present knowledge, and the practical importance of each subject is pointed out. All the apparatus of practical merit is described and the book fully justifies its sub-title. The Engineering Record rarely feels justified in advising the reading of a technical treatise as a matter of pleasure, yet it unhesitatingly recommends this book to all its readers, feeling confident they will be well paid for its perusal.

Letters to the Editor.

PROPERTIES OF CIRCLES.

SIR:—With reference to the correspondence under this heading in your valuable paper a much closer formula for ordinates to circular curves is the following:

$$V = R \div \sqrt{R^2 - C^2/4} \quad (1)$$

$$y = \sqrt{R^2 - x^2} - (R - V) \quad (2)$$

Where R = radius in feet, where C = chord in feet, where V = versin or rise at center of chord in feet, where x = abscissa or distance from center of chord in feet, where y = ordinate, or perpendicular distance from chord to arc, at end of x .

Equation (1) gives the central ordinate and from (2) can be found any number of intermediate ordinates.

Yours truly,

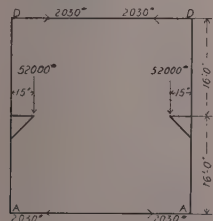
HENRY ADAMS.

London, Aug. 18.

A MILL BUILDING PROBLEM.

SIR:—Referring to the solution of the problem in the mill building post given in your issue of the 26th inst. by Dr. Myron S. Falk, I do not agree with the analysis or the deductions given. Dr. Falk starts out in his analysis with the statement that it is impossible to determine exactly the condition of fixedness of the ends of the column at A and D or F . Then he states that it is sufficiently accurate to assume it fixed at A and D . Now the detail shows the column anchored down at A , and it is, therefore, correct to assume that it is fixed to the extent of the strength of that anchorage, but not to the extent of the full strength of the column section. It is apparently a condition that has confronted "Enquirer-Subscriber" and not a theory, though it would be better for the public good if such construction existed only in text books. He assumes, in his analysis, as stated, that the column is fixed at D . This is the top end of the column and merely supports the roof trusses or brackets. It is hard to see what holds the column fixed at such point. Again he says that the column might have been assumed as hinged at A and F . Now F is a point $3\frac{1}{2}$ ft. from the end of the column and in the solid body of the same. If there is any point where it could without question be assumed fixed, it is at F , as it is there held by the continuation of the bottom chord of the trusses.

He states further that the bending moment due to the crane load at E is 780,000 inch-pounds, and the same throughout the post. If it is the same throughout the post, it is that amount at D . What takes it there? There must be some resisting moment. At this point there is nothing shown but two brackets upon which the trusses rest. How could such a detail take a bending moment of 780,000 inch-pounds?



Taken apart from the building the problem of the load from traveling crane may be represented as in the small figure. The couple or bending moment in each column caused by the overhanging crane load must be met by an equal couple in each column. This can be supplied by the forces, A and D , the amounts of which are $52,000 \times 15 \div 32 \times 12 = 2,030$ lbs. This would give uniformly increasing bending moments in the column—zero at A and D increasing to 390,000 inch-pounds at the crane bracket. In the crane bracket

itself these bending moments would unite to give the 780,000 inch-pounds if that bracket extended to the center of column, but this is not the case. There is no warrant for the deduction that the column is subjected to 780,000 inch-pounds throughout its length, or in any part of its length. If the column were standing free, without any brace whatever from the ground up, it would have that moment from ground to crane bracket.

In the case of the jib crane, while the thrust in the truss through D would not be met by an equal thrust from the other post, it could be assumed that part of the horizontal thrust at D is resisted by the other post giving a bending moment at its base, instead of assuming that the first post is fixed at D with a large bending moment that vanishes into the air at that point. Of course the load from traveling crane may not be equal on the two columns. The unbalanced thrust at tops of columns can be divided between the columns producing a bending moment at their bases. Or the adjoining building with the steel columns may be rigid enough to take these horizontal thrusts. The critical section of the columns from the standpoint of bending moments would then be the splice above the crane bracket. If this splice will not develop the strength necessary to take the full horizontal thrust at D , the surplus must be taken at base, A , of column.

Very respectfully,

EDWARD GODFREY.

Pittsburg, Aug. 29.

SIR:—I have noted, with much interest, in the current issue of your valuable paper, the solution of Enquirer-Subscriber's column problem as given by Dr. Myron S. Falk. Does he not fail to recognize that he is dealing with a column as well as a beam and that, consequently, there will be a material addition to his results (assuming them correct for as far as they are carried), due to the moment caused by the deflection of his beam times the resultant direct load. Also, good practice prescribes that in a column where the ratio of the length to the radius of gyration exceeds a number generally about ten, some allowance be made for this condition, either by some type of Gordon's formula, or by using one of the common straight lines formulas. Consequently, Dr. Falk's "greatest" stresses obtained by adding, algebraically, the direct stress to the stress caused by the bending moment due to transverse and eccentric loads on the column are incorrect, since they are not the actual maximum stresses asked for by your correspondent. These additional stresses neglected by Dr. Falk are, of course, in this instance, of only academic interest, as his figures apparently show that the column is much overstressed, yet this can hardly be adduced to excuse a result a thousand pounds or so in error, or to sanction an approximation on the unsafe side.

In conclusion, the writer would advocate with all possible emphasis, that a general survey be made of every problem submitted and that the detail calculations be started only after the conditions of the problem have been thoroughly digested.

Yours truly,

J. H. BROWNE.

Pittsburg, Aug. 30.

SHEARING STRESSES IN MASONRY.

SIR: Your editorial in The Engineering Record of Aug. 26 on "Shearing Stresses in Masonry" is timely, and I fully agree with its conclusions as to the importance of shearing stresses in the resistance of masonry beams, especially of the reinforced concrete type, as well as in all masonry structures. But, I believe, exception should be taken to the following statement in your editorial: "There are few tests of either natural or artificial stones in compression whose results do not furnish a reasonably accurate basis for computing

the ultimate shearing resistance. Indeed, the so-called failures by compression of cubical or cylindrical test specimens of nearly all good building stones, whether natural or artificial, are actually shearing failures. Those who have conducted compression tests of stone have many times observed the interesting forms in which the fragments are separated in the fractured specimens. Wedge-shaped pieces are usually sheared off along planes making angles of about 45 degrees with the direction of the applied loads, precisely as the theory of stresses in solid bodies indicates that they should. The manner of holding test pieces prevents these shearing planes from making the exact angle of 45 degrees which theory indicates to be the angle of maximum shearing intensity, but the divergence is small. The crucial fact is the failure by shear, although the maximum test load is recorded in pounds per square inch of compression. It is this persistent neglect to record the failure under its true name which has so long obscured the perfectly obvious action of shearing stresses in masonry."

The failure of short members of natural or artificial stones in compression does not, in the light of recent investigations, appear to be due to the shearing stresses, as it has been assumed heretofore. This point is, at least, a much-disputed one. Considère says in his "Experimental Researches on Reinforced Concrete," p. 119: "It was admitted, up to the present time, that the different varieties of stone, mortars, and concrete, when under compression, always failed by shearing along planes inclined to the direction of the stress. The recent experiments made in Germany by Foeppel and repeated by Mesnager at the laboratory of l'Ecole des Ponts et Chaussées have proved that this mode of failure is due to the friction exerted on the lower planes of the test specimens by the plates transmitting the pressure. And it has further been proved that by sufficiently reducing this friction by the introduction of a greased surface, the failure will take place along surfaces which will be parallel to the direction of pressure."

The writer was unable to see the published results of the experiments referred to in the above, but he recently came across a statement by Prof. Foeppel on the subject in his "Festigkeitslehre," Vol. 3 of "Vorlesungen ueber Technische Mechanik," which is thought to be of interest. Discussing the shearing stresses in a granite cube under pressure, Prof. Foeppel states: "The problem refers to an opinion which was formerly widely held as to the character of the failure of stone cubes. Stone cubes failing under pressure on two opposite sides break so that frequently very nicely formed pyramids are obtained. The surfaces of the pyramids, that is, the main surfaces of rupture, follow approximately the planes of greatest shear. It was thence concluded that the prism failed by overcoming the shearing resistance. The following explanation is, however, more plausible. When the prism is under compression a swelling or lateral extension takes place. Stone, however, can sustain without rupture, a given specific elongation only. It is probably indifferent whether this elongation is caused by tension in the same direction or by compression in a lateral direction. The failure of the specimen is thus to be explained by the splitting off of pieces on the four free sides, leaving the pyramids. In fact, in some compression tests Bauschinger has not obtained pyramids but prisms with edges parallel to the main direction of stress which points directly to the explanation given in the above.

"Still another important condition must be taken into account in explaining the pyramidal form. The friction between the compression sides of the stone and the bearing plates of the testing machine hinders the lateral expansion of the stone. This prevents any lineal stress near the compression sides. The adjacent sections are also

hindered in their free lateral expansion, and it must, therefore, be expected that the failure will start at the middle where the effect of the frictional resistance extends least. If it is then considered that the friction prevents any lateral expansion of the compression sides and that a crack extending through them is, hence, hardly to be expected, the almost pyramidal form of the portion remaining after failure is easily understood. This consideration also accounts for another phenomenon which is observed in tests of stones in compression. The resistance is found to be dependent on the ratio of the height of the specimen to its base; the greater its height, the smaller its resistance usually is. As the effect of the compression bases, which are held together by friction, is not felt so much at the middle of prisms of greater height, this phenomenon explains itself. It may also be mentioned that the writer recently made compression tests on stone cubes with lubricated compression sides. In this case the stone splits not in inclined directions but in vertical so that a series of prisms are obtained. The ultimate resistance is much less in this case ($\frac{1}{2}$ to even $\frac{1}{3}$ and $\frac{1}{4}$) than the one observed without lubricated compression sides.

"It is customary to test the compressive resistance of stones on specimens of cubical form with compression sides not lubricated. It is well to take into consideration the above remarks in discussing the results obtained from such tests."

In view of the above statements by experimenters as eminent as Considère and Foeppel it seems that a revision of the old established ideas on the failure of stones in compression is about to take place and much additional information on the subject is wanted.

Respectfully yours,
LEON S. MOISSEIFF.

New York, Sept. 1.

STEAM TURBINE PUMPS FOR WATER-WORKS.

Sir:—In your editorial "Steam Turbine Pumps for Water-Works" in your issue of August 5th, haven't you, like the stump speaker, "drawn on your imagination for your facts"?

First, you have assumed an efficiency at least 10 per cent. higher than centrifugal pump makers seem willing to guarantee, and secondly, you have made the further assumption that the plant would be operated but half the time.

While perhaps the centrifugal pump "ought to give 85 per cent. efficiency" (on the theory of the reversibility of motors), yet the fact is that but few pumps have reached 80 per cent. efficiency, and those only on special tests, and there is no special reason to believe that the working efficiency of the centrifugal pump is likely to be brought up to 80 per cent. in the near future.

The De Laval centrifugal pumps tested by Professors Denton and Kent gave efficiencies ranging from 71 per cent. to 75 per cent. with duties of from 49,000,000 to 62,000,000 per 1,000 pounds of steam.

Otto H. Meuller, in a recent issue of the *Journal of the German Engineers' Society* (July 22, 1905) gives figures of the tests of several turbo-centrifugal pumps, the efficiencies of which range from 74 per cent. to 78 per cent., the pumps being of the two, four and six-stage types, pumping against heads ranging from 141 ft. to 361 ft.

Mr. Meuller, in his paper, says: "Like all new things, the turbo pumps, after their first successes, were greeted with great expectations, which have led to exaggerations prejudicial to a correct application of the machine and the extension of its field. The development of the turbo pump shows that its most advantageous place is where electric transmission can be used to advantage—that is, for deep mines, sinking pumps, inaccessible pumping stations or portable pumps, and auxiliary pumps for electric power houses, per-

haps with the exception of boiler feed pumps, for which the electrically driven turbo pump does not possess the required range of regulation."

The centrifugal pump is essentially a constant-quantity and constant-head machine, and all efficiency curves show that any wide departure either as to capacity or head results in an immediate loss of efficiency, and this feature brings up the point which you raise when you assume that the pump will operate only half the time.

While it is true that practically no pumping stations operate all of their machinery at full speed all of the time, yet the reserve machinery is usually of an obsolete or uneconomical type, and it cannot for a moment be assumed that in installing new machinery the purchaser would consider the idea of having it remain idle 50 per cent. of the time. As a matter of fact, in installing new and economical machinery, it is usually expected that it will be in operation from 75 to 90 per cent. of the time, and there are numerous instances where this percentage is exceeded; but in many cases where the pumping is on direct service, new engines, especially if of larger sizes than the requirements of the service demand, may be operated at about half capacity, but there is a vast difference between operating at half capacity and operating one-half the time, particularly when centrifugal pumps are considered.

The loss in economy from operating a high duty pumping engine at half capacity, would be from 5 to 10 per cent. of the maximum economy, while a centrifugal pump operated at half capacity would have a very much greater loss in efficiency, and your suggestion of by-passing the surplus water would be far from economical.

The above refers to the centrifugal pumps only, but when coupled with steam turbines still another element of loss appears. The steam turbine is essentially a constant-speed machine, and can be nothing else if reasonable economy is to be obtained, and therefore a steam turbine-centrifugal-pump outfit would require to be operated at constant speed, against a constant pressure with a constant discharge in order to show even reasonable economy.

The very remarkable figures for steam consumption which are published in connection with steam turbine performances are usually for engines of much greater power than is ordinarily required for a pumping engine and operating, as a rule, with highly superheated steam. The horse power of pumping engines is relatively small, a 20,000,000 gallon engine, working against ordinary heads, usually ranging from 500 to 700-hp., and there are but few engines in service which exceed 1,000 h.-p.

Again referring to Mr. Meuller, he says: "The economical velocity of the steam turbine in most cases requires that the water flow to the pumps under pressure, or else that the pumps be separated into parallel working sets. The first method is seldom practicable and the second is uneconomical. In addition, the steam turbine in its present form is not sufficiently economical for as small units as are used in pumping stations to even partly offset the low efficiency of turbo pumps against reciprocating pumps (at best 82 per cent. against 95 per cent.) Numerous calculations show that up to 1,000 h.-p. capacity, a steam-turbine-turbo-pump set used at least 50 per cent. more steam than a reciprocating pump of the best design and make; and for small units, up to 60 h.-p. even the first cost is in favor of the economically superior piston pumps. Consequently it is only in cases where a saving in weight and space is important that a decision can be in favor of a steam turbine for the operation of turbo pumps."

Along this same line, Professor Denton in his paper presented before the International Engineering Congress at St. Louis, 1904, entitled, "The

Best Economy of the Piston Steam Engine at the Advent of the Steam Turbine," after referring to the performances of a number of well known reciprocating pumping engines, says: "The turbine can compete with these pumping engines only through the medium of a multiple-stage centrifugal pump, whose efficiency, taken even at 80 per cent. will probably impose too great a loss of motive power on the turbine system for successful competition with this high class of piston pump, since the friction loss of the latter is only 5 per cent. of the indicated horse-power."

That the steam-turbine-centrifugal-pump is not likely to prove economical in general water-works service, would seem to be indicated by the experience of the few engineers who have asked for bids on machinery of this class, as in each of the following instances the reciprocating pump has been selected in preference to the turbine:

The City of Providence, R. I., advertised about eighteen months ago for a 20,000,000 gallon pumping engine, and turbine-driven centrifugal pumps were offered at a price of \$73,000, and a vertical triple-expansion reciprocating pump at \$95,000, both figures including the necessary boilers. The turbine pump was guaranteed to give a duty of 88,000,000 ft.-lbs. per 100 lbs. of coal, and the reciprocating pump 149,000,000 ft.-lbs. per 100 lbs. of coal. The annual cost of operation figured out \$45,500 for the turbine and \$29,000 for the reciprocating pump, these figures including interest, depreciation, repairs, coal, oil and waste, the turbine pump being credited with the same rate of depreciation as the reciprocating engine, which I consider as unfair, as it is hardly to be expected that the wear on a machine running at several thousand revolutions per minute would be as little as one running at about 25 revolutions per minute.

The City of Woonsocket recently received bids for a 5,000,000 gallon pumping engine, and was offered a turbo-centrifugal pump for \$10,000, the guaranteed duty being 88,000,000 ft.-lbs., yet found it more economical to purchase a reciprocating pump for about \$16,000 with a guaranteed duty of 130,000,000.

The Brooklyn (N. Y.) Water Department, some months ago advertised for a turbine-driven centrifugal pumping engine, but I understand received no satisfactory bids on it, and the same Department is now advertising for a centrifugal pumping plant, to be driven by compound reciprocating engines.

Your idea of figuring the pumps to run only one-half of the time is really the key to the whole problem, for turbo-centrifugal pumps, like all uneconomical machines, make the most favorable showing in comparison with high economy machines, in direct proportion to the time they remain idle, for the very obvious reason that interest on first cost is magnified, while the cost of fuel is minimized, and if you had figured that the machines would remain idle 75 per cent. of the time, instead of 50 per cent., the showing would have been still more favorable to the turbo-centrifugals.

That the multi-stage centrifugal pump has a wide field for application is not to be questioned for a moment, and in some cases (where it can be operated at constant speed) it may be properly coupled with the steam turbine, but its economical field will, for the present at least, be largely confined to emergency work rather than continuous operation, and to special service where fuel economy is of secondary importance, and for such kinds of work it is eminently fitted; but for regular water-works service I do not believe that it can successfully compete with reciprocating pumping engines of the high duty type.

Yours truly,
IRVING H. REYNOLDS.

Youngstown, O., Aug. 30, 1905.

CURRENT NEWS SUPPLEMENT

SEPTEMBER 9, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Chas. Warren Hunt, 220 West 57th St., New York. Next meeting, Sept. 20, paper on river and harbor improvements.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, F. R. Hutton, 12 West 31st St., New York.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty St., New York.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, W. H. Merrill, Jr., Chicago.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, R. W. Raymond, 99 John St., New York.

AMERICAN INSTITUTE OF ARCHITECTS. Secretary, Glenn Brown, Washington, D. C.

ASSOCIATION OF ENGINEERING SOCIETIES. Secretary Frederick Brooks, 31 Milk Street, Boston, Mass.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, W. M. Mackay, 235 Water St., New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

AMERICAN PUBLIC HEALTH ASSOCIATION. Secretary, Dr. C. O. Probst, Columbus, O. Annual meeting, Boston, Sept. 25-29.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS. Secretary, S. F. Paterson, Concord, N. H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION. Secretary, L. C. Fritch, 1562 Monádnock Block, Chicago.

AMERICAN WATERWORKS ASSOCIATION. Secretary, J. M. Diven, Charleston, S. C.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Richard Moldenke, P. O. Box 432, New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

AMERICAN PUBLIC WORKS ASSOCIATION. Secretary, W. H. Flint, Chattanooga.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

CONDITION OF STEEL AND IRON TRADE.

The recent expansion of business in the steel and iron trade is the subject of the following comments in "The Iron Trade Review" of Sept. 7:

Sales of rails since the price of \$28 for 1906 delivery was announced last week have been tremendous, breaking all records and furnishing substantial evidence of great prosperity in the iron business, present and prospective. It is estimated that the orders for rails for 1906 placed within a week will amount to 650,000 tons, and orders for several hundred thousand tons are pending.

Although the United States Steel Corporation has booked large orders, it has not alone enjoyed the unexpectedly heavy business from the railroads. The Colorado Fuel & Iron Co. reports its entire rail output sold for 1906, and the Tennessee Coal, Iron & Railroad Co., the Lackawanna Steel Co. and other interests are well supplied with orders.

Among the bookings of the last week were the following: Chicago & Northwestern, 70,000 tons; Burlington, 50,000; Santa Fe, 50,000; Chicago, Milwaukee & St. Paul, 65,000; Wisconsin Central, 22,000, and Great Northern, \$40,000.

Accompanying the orders for rails are many orders for cars and locomotives. The Pennsylvania system has ordered 15,000 steel cars. Other railroads have bought liberally and inquiries for at least 75,000 steel and wooden cars are pending. The announcement of an advance of \$2 a ton on structural shapes, although not expected, is received by the trade as justified by market conditions. Orders for more than 20,000 tons of structural steel were placed at Chicago last week. The market for pig iron is rather quiet, but in nearly all selling centres there is an improved tone. The demand for plates and steel bars continues strong, and the trade would not be surprised to hear of an advance on these products at an early day.

The American Shipbuilding Co. has placed contracts for plates for three large freighters, and additional con-

tracts are pending. There is already considerable complaint about car shortage. This is especially true concerning coke, for which the demand has become so strong that the railroads are finding it difficult to give prompt shipments. Some jobbing interests also complain that they cannot get cars promptly.

JUDICIAL DECISION AFFECTING THE HARVARD M. I. T. UNION

On Sept. 6 the Massachusetts Supreme Court ruled that the Massachusetts Institute of Technology could not use more than one-third of its estate in Boston for buildings, and could not sell the property under the grant given by an act of the Legislature in 1861. Two of the justices dissented. The construction of the grant made has an important bearing on the Harvard-Technology merger plan, as the corporation planned to sell its property when the consummation of the scheme rendered its further use unnecessary.

Under the terms of the grant to the Institute of Technology and the Natural History Society, the square now occupied by both was to be reserved forever as an open space, or for the use of the two institutions, but neither to cover more than one-third of its area with buildings. By an act of the Legislature of 1903, the Institute of Technology was authorized to build a building which, with the present ones, would occupy more than one-third of the land, and also to sell the whole area to others to build upon. Abutting property owners brought the suit.

ENGINEERS FOR THE NEW YORK BOARD OF WATER SUPPLY

At a hearing held Sept. 5 before the Civil Service Commission, the Association of the Civil Employees, the Civil Service Reform Association and many engineers in the employ of the city showed persistent opposition to the exempting of twenty-seven more positions on an application made by the Board of Water Supply. The full commission, composed of William F. Baker, president; Alfred J. Tally and R. Ross, heard the testimony of both sides.

Explaining the reasons for the demand, Commissioner Chadwick, of the Water Board, said that the board had no desire to attack the Civil Service, but that necessity demanded that these positions be exempted. He pointed out the fact that a greater water supply was needed in New York City at once, and that to get it a large force of engineers would be needed. He said that these must be the best in the profession, and that to get them through the regular course of the Civil Service would not only be too slow, but, in some cases, it would be impossible. He said that in the next two or three years one thousand engineers would be needed.

W. J. W. Greene, of the Law Committee of the Civil Service Reform Assoc.; George R. Crowley, representing the Association of Civil Employees, and S. William Briscoe, representing the municipal engineers, opposed the demands on the grounds that the exemptions asked were excessive, that it was weakening the protective power of civil service, and would serve as a precedent for demands of a like character on other boards.

Waldo Smith, chief engineer of the Water Board, pointed out that properly qualified men could not be obtained from the classified lists.

FOREIGN STUDENTS IN PRUSSIAN TECHNICAL SCHOOLS.

U. S. Consul Kehl, of Stettin, explains as follows the new regulations issued for the admission of students to technical high schools in Prussia:

The students will be divided into three classes—the "regular attending students," students for lectures only and lecture visitors. As regular students, without any exception, such young men will be accepted who have acquired the knowledge necessary for being admitted into any university, said knowledge to have been acquired at a German "gymnasium," a German "ober-realschule" (a high school in which sciences as well as art and languages are taught), a Bavarian "industrial school," or the Saxonian Polytechnical Academy of Chemnitz. As to foreigners, the ministry of ecclesiastical affairs and public education is to decide whether their scholastic erudition is sufficient to admit them. German subjects, other than Prussian, will be admitted under the same conditions as Prussian subjects.

As students admitted to hear the lectures only (i. e., without privilege of being graduated by the board of examiners), young men will be admitted, not possessed of the education necessary for being admitted into a German university, but having acquired the schooling necessary for performing only one year's military ser-

vice. The admission of such students is put into the hands of the rector of the technical high school.

As lecture visitors such persons may be admitted to the lectures or demonstrations who are not eligible to either of the two classes just mentioned. The admission of lecture visitors will be granted by the rector, with the consent of the proper professor. There is particularly one new restriction in these regulations, viz., that all encouragements for foreigners are dropped. Setting aside the lecture visitors, only such foreigners will be admitted who are capable of complying with the German educational requirements or who are in possession of an "equivalent foreign certificate of learning."

PUBLIC UTILITIES IN FRANCE.

U. S. Consul-General R. P. Skinner says in a recent report that any one seeking information in regard to the ownership of public utilities in France might profitably consult the following works: Fleury: "Excursions dans le domaine du Socialisme, Dangers du Collectivisme, etc.," 1 volume, 2 francs. Alf. Naquet: "Le Socialisme Collectiviste et le Socialisme Libéral," 1 volume, 2 francs. Paul Leroy-Beaulieu: "Le Collectivisme, Examen Critique du Nouveau Socialisme," 1 volume, 8 francs. He says further:

"Private ownership not only of public utilities, but of the air above the earth and the water beneath the surface thereof, is subject in France to restrictions which do not obtain in America. In practice gas works and other public and semi-public utilities are frequently operated and owned by private corporations, but the concessions under which they are operated usually limit this ownership and reserve to the people at least a share in any advantage resulting from improved methods and the increase of population. City houses are limited as to height, and, while landed proprietors may do anything they like with the surface which they own, the hidden contents of the earth belong to the nation and can be mined only by first obtaining a concession from the State. Before any such concession is granted due notice is given to the public, and the owner of the surface derives no particular advantage from that fact in laying his proposition for a concession before the national authorities.

"French railroads are constructed by corporations, and are usually operated under concessions given for a long term of years, with a provision by which the State reserves to itself the right to purchase the lines ceded, and by which at the expiration of the concessionary period the property reverts automatically to the State. During the term of the concession, if the private company owning the property fails to earn reasonable interest upon the bonds, the State makes up the deficiency.

"The city of Marseille owns its water-works and like wise a very important canal connecting this city with the River Durance. In addition to supplying the community with water the city supplies the same for irrigating purposes to agriculturists whose property is within reach of the before-mentioned canal. There are also in the south of France, particularly, innumerable irrigation canals, which are usually the result of co-operation on the part of the interested land owners. The State has organized a government department called the bureau of agricultural ameliorations, which furnishes, upon the request of interested localities, complete plans for the proper construction of these canals, without charge, and the law provides that when a majority of the land owners within a given area have determined that the construction of an irrigation canal is necessary the unwilling minority must participate in the expense of construction or submit to expropriation. If the numerical majority of land owners controls but a small fraction of the actual surface to be irrigated, they may be outvoted by a minority whose landed interests are greater.

"The gas contract in the city of Marseille is now held by a private company, and a new contract constitutes an important local issue. There appears to be no general demand for immediate full municipal ownership. The street railways of Marseille are all owned by the Compagnie Generale Francaise de Tramways. The service is excellent; there are lines in every direction. With the exception of one circular line of special character, upon which the fare is 3 cents, the fare is everywhere else 2 cents. No transfers are given. The concession for these lines was originally granted by the State to the city of Marseille and by the city conveyed to the operating company. It is to be noted that the municipality does not exercise a free hand in municipal matters, but must first obtain a concession for itself from the national government. The concession in this case was signed originally for fifty years, at the end of which period, and by the sole fact of this expiration, the city will obtain full ownership of

the tracks and system, including all property occupying any portion of the public domain.

"There are abundant means of preventing deterioration of the property during the last five years of the concessionary company's exploitation, in consequence of willful negligence. Provision is also made for the acquisition upon reasonable terms of all buildings, machinery and rolling stock necessary for the exploitation of the system at the expiration of the fifty years. In the meantime the company must pay to the city an annual sum of \$19,300 until the annual receipts reach \$1,351,000, whereupon, in addition to this payment, the city will also receive 4 per cent. upon the excess of receipts over \$1,351,000 and up to \$1,544,000. When the receipts reach the last-named amount in any one year the city will be entitled to an additional 1 per cent. upon such excess until such excess reaches \$193,000, and thereafter for every additional 1,000,000 francs (\$193,000) of annual receipts 1 per cent. will be added to the city's share.

"The harbor of Marseille is likewise controlled by the State as the property of the nation. The State has leased control of the most important sections to a public-service corporation, which has charge of the bonded warehouses. The concession for the erection of these warehouses was originally granted to the city and by the city assigned to the Compagnie des Docks et Entrepôts, which pays the municipality an annual rental of \$19,300 for this privilege. This company is subject to close supervision both as to services performed and charges which may be made for services. Other portions of the city water front are controlled by the Chamber of Commerce, which has built docks and warehouses of the most permanent character and lets them for the benefit of the whole community.

THE SLAG CEMENT MILL OF THE ASHLAND IRON AND MINING CO.

A slag cement plant has recently been put in operation at Ashland, Ky., by the Ashland Iron & Mining Co. which is particularly well adapted for economical production. The company has its own collieries which furnish the fuel for the dryers, and the power costs nothing for fuel as the waste gases from the blast furnaces are employed for raising steam. The slag from one of the furnaces is run directly into a large concrete pit where it is granulated, and the lime is prepared at the works in a Broomell kiln and hydrated before going to the storage hopper in the mill building. The granulated slag is taken from the pit as needed by a Brown locomotive crane and carried to a hopper outside the mill. From this hopper it is raised by a bucket conveyor and carried by a screw conveyor to three Ruggles-Coles dryers 30 ft. long and 70 in. in diameter. The surplus slag delivered to the dryers is returned to the elevator pit by another screw conveyor. After drying the slag is conveyed and elevated to a steel bin adjoining that in which the hydrated lime is stored.

The two materials are fed automatically by a measuring apparatus into the first of four 5x22-ft. Allis-Chalmers tube mills, where the mixing and rough grinding is done. From this mill it is fed to the others which finish the grinding and deliver the product to the elevators and conveyors taking it to the stockhouse. The latter has four bins, each of 2,500 lb. capacity. The cement is drawn from these by a system of conveyors and elevators and delivered to the bagging department, where hand apparatus is used.

The boilers of the power plant for the new mill are installed at the furnace furnishing them with gas, and

THE KING-LAWSON DUMP CAR.

The Delaware, Lackawanna & Western R. R. has been testing a dump car built by the Middletown Car Co. from the designs of Messrs. Thomas Lawson and George I. King. It has a box 28 ft. long, 7 ft. wide and 20 in. deep holding about 500 cu. ft. when heaped full. The sides are arranged so that they rise automatically as the body is tipped. The dumping is done by moving the box laterally 18 in. and then raising one side by two pneumatic rams until the box strikes against the stops limiting its motion. The rams are furnished with air from two tanks connected with the train pipe. It is believed that 10 lb. pressure will raise the box empty and from 55 to 60 lb. will be required when empty. This car has been dumped on the low side of a track of which one rail was elevated 3½ ins. above the other. A load of 30 tons of pig iron mixed with car wheel scrap has been dumped in 30 seconds and 25 tons of water-soaked clay in 15 seconds, both loads being thrown entirely outside of the rails. From experiments, Mr. King believes this type of construction to be entirely satisfactory for loads up to 30 tons.

STEAM HOSE NOTES.

It is well-known that the heat of the steam in steam hose tends to cause the inner tube to lose its elasticity because the rubber becomes over-vulcanized or burned. This is particularly so if it is subjected to higher steam pressure than is employed in vulcanizing. The steam pressure also causes considerable expansion and when the pressure is released, the inner tube is likely to lose its life and elastic qualities and crack. Eventually the



THE BOARD OF CONSULTING ENGINEERS OF THE ISTHMIAN CANAL COMMISSION.

The names of those standing, beginning at the left, are: Capt. John C. Oakes, Corps of Engineers, U. S. A., Secretary of the Board; Gen. Henry L. Abbott, Corps of Engineers, U. S. A., Retired; Herr Eugene Tincauer, German Delegate; M. E. M. Quellenee, of the Suez Canal Staff; Isham Randolph, F. P. Stearns and W. H. Burr.

The names of those seated, beginning at the left, are: Joseph Ripley, W. H. Hunter, chief engineer of the Manchester Ship Canal; M. Adolph Guerard, French Delegate; J. W. Welcker, Dutch Delegate; Alfred Noble, Gen. Geo. W. Davis, chairman, and Wm. Barclay Parsons.

"The Chamber of Commerce is itself a recognized branch of the public administration and is not a private corporation, as is the case in America. In France every man who pays a business tax or 'patente' is entitled to vote for members of the Chamber of Commerce, and also to transact business upon the floor of the bourse. The Chamber of Commerce is a legislative as well as an administrative body, communicating officially with the Minister of Commerce and, through him, the National Assembly. It thus happens that there is more real democracy in French business circles than in the United States, where seats in our commercial bodies are bought and sold like any other article of value. The result of the system is that the Chamber of Commerce is quickly responsive to the sentiment of the business community, and the annual elections frequently take place with as much excitement as accompanies the ordinary municipal and State elections. The business community also elects a tribunal of commerce, which has final jurisdiction in a large variety of commercial cases, and which sits in the Chamber of Commerce building. Both the members of the Chamber of Commerce and of the Tribunal of Commerce must be actively engaged in business pursuits."

Mr. J. G. Sullivan, division engineer of construction of the Canadian Pacific Ry., has been offered the position of assistant engineer of construction on the Panama Canal.

the engine house is immediately adjoining. It contains a Corliss engine built by the Atlas Engine Co. and a Stanley generator. The tube mills are each driven by a 75-h.-p. motor; these motors drive the mills directly but are located in a separate room from the mills so as to be free from the dust which is present near the latter. One 30-h.-p. and two 15-h.-p. motors drive the dryers, and the largest one also runs some of the elevating and conveying equipment. A 15-h.-p. and a 20-h.-p. motor furnish the remainder of the power needed in the mill and stockhouse. All the motors are of the Stanley make.

The buildings are of steel and concrete blocks, no wood being used except in the windows and doors. The concrete blocks are made of 1 part slag cement furnished by the Stewart Iron Co. at Sharon, Pa., 2 parts sand and 5 parts of crushed slag. The transmission machinery, elevators and conveyors were supplied by the Webster Mfg. Co., of Chicago, and are so laid out that there is no handling of the materials from the time they are fed to the dryers and lime conveyor until the finished cement is bagged. The plant was designed by the Curtin-Ruggles Co., 39 Cortlandt St., New York, and is in charge of Mr. Simon Beard.

Mr. A. H. Valiquette, formerly with the Rand Drill Co., at Pittsburgh, has been appointed Eastern representative of the Blaisdell Machinery Co., with offices in New York.

steam enters the interior of the hose through these cracks and tears the rubber away from the cloth insertions. The rubber then crumbles up and sometimes blows into the steam chest of the drill. The tearing away of the inner tube leaves the cloth insertions bare and the hose will thus become useless, as the steam will blow it to pieces when the inner tubes are damaged. With a new type of hose known as flexible steel-armored hose, the nature of the armor prevents expansion, and the armor strips are so tightly interlocked that it is impossible for the steam to blow the hose to pieces. This is not the only advantage of the armor, however. Steam hose in being dragged around rocks is very liable to kink. Kinking will in a very short time break the hose from the outside and it will then burst, being unable to stand the pressure. This kinking is overcome in the flexible steel-armored hose as the nature of the armor maintains a uniform internal diameter and makes it impossible for the hose to kink.

The steel protection of the flexible steel-armored hose, which is entirely different from wire coils, entirely covers the inner rubber hose and is interlocking, and if it should so happen that the inner rubber hose becomes damaged, the flexible armor prevents an open rupture, with the result that sufficient steam pressure is maintained to continue the use of the hose. A drill or other machine can thus be continued in use with a damaged hose until it is convenient to replace it with another

piece: Further information concerning this new hose may be obtained by writing to the manufacturers, the Sprague Electric Co., 527 West 34th St., New York.

CALIFORNIA OIL ASPHALTS.

Considerable attention having been called to the controversy over oil asphalt for paving mixtures between the different boroughs of New York City, The Engineering Record reprints here a report by Mr. N. P. Lewis, chief engineer of the Board of Estimate and Apportionment, made on Dec. 2, 1904. The introductory paragraph referring to the official communications on the subject then before the Board is omitted, but the following portions are given without change:

It seems scarcely necessary to review all of these reports and the correspondence, and I will confine my comments to the report of Mr. McLean and the circumstances which have led up to the present controversy. Early in the year a communication calling attention to the unsatisfactory condition of the asphalt pavements in the Borough of Manhattan, and expressing the conviction that such condition was caused in a large degree by the deleterious effect of water upon the material used in such pavement, was referred to the President of the Borough, his Chief Engineer of Highways and myself. Several conferences were held, and a joint report was submitted to the Board of Estimate and Apportionment recommending certain changes in the specifications for asphalt paving in the Borough of Manhattan. This report was approved by the Board, and the changes were directed to be made in the paving specifications of all five boroughs. At a subsequent meeting the President of the Borough of Brooklyn requested that the resolution be so amended as not to apply to his borough, as he thought that the effect of the amendment would be to materially restrict competition. Not only was his request complied with, but the amendment was made applicable only to the Borough of Manhattan.

This amendment provided that no refined asphalt should be used which contained less than 90 per cent. of bitumen. This resulted in excluding the so-called Trinidad asphalt, but as the company controlling that material also had others which would comply with the new requirements, it was not thought that its exclusion would limit in any way the number of bidders for asphalt paving. The amendment also provided that no asphalt produced from the distillation of asphaltic oils would be accepted. This, it was frankly admitted, might somewhat restrict competition, but though it was known that some excellent pavements had been made from oil asphalts, it was thought that the product was naturally somewhat unstable, and that if the production of asphalt was only an incident in the distillation of oils to obtain the lighter material, instead of the principal end of the operation, the material obtained might prove unfit for paving purposes.

So far as the use of oil asphalts in this city is concerned, it has for some time been believed that some such material had been used. In the Borough of Brooklyn, where the highway work was in my charge until March, 1902, I became satisfied that, while the earlier pavements laid under the name of Alcatraz asphalt were made from a hard, natural bitumen, some of those more recently furnished by the Brooklyn Alcatraz Asphalt Co. were made of an oil asphalt. The contractors, with apparent sincerity, said that they used the material which was furnished them by the producers, and that they were not sure what they were using. It must be admitted that the earlier pavements of that company, in which they were known to have used a hard, natural asphalt, were inferior to those laid subsequently. The extent to which oil asphalts have been used in this city is probably known only to those who furnished the material. The most experienced engineers in charge of paving will, I think, frankly admit that they do not know.

Since the amendment of the Manhattan specifications, I have received a statement made by Mr. A. S. Sampson, who prescribed the paving mixtures for the Brooklyn Alcatraz Asphalt Co., the Atlantic Alcatraz Asphalt Co. and the New York Asphalt Construction Co., in which he says: "I find by my records all the pavements laid by the Brooklyn Alcatraz Asphalt Co. since July 25, 1898, up to Jan. 1, 1902, were made of the distillate oil asphalt. All of the pavements laid by the Atlantic Alcatraz Co. in Jersey City in the year 1899, also many streets laid in New York City by them during that year, were made of California distillate oil asphalt; also all pavements laid by this company in New York and Jersey City during the year 1900, up to October of the same year, were made of distillate oil asphalt. All pavements laid by the New York Asphalt Construction Co. since September, 1902, up to Jan. 1, 1904, were also made of the distillate oil asphalt."

I believe Mr. Sampson to be a man whose statement can be relied upon. Since receiving this information I have examined a large number of the pavements in the Borough of Manhattan which, according to Mr. Sampson's statement, were made of oil asphalt. Some of them had been badly mutilated by plumbers' cuts and openings made for various purposes, but I found them to be in uniformly good condition and to compare favorably with those made from other asphalts.

Mr. McLean called upon me before making his report to the Comptroller, and I told him what impression I had gained from this inspection, although I do not think I said that I found them "in better condition than any examined," as he quotes me as having said in his report. I further said to him that, in view of the specific statement of Mr. Sampson, indicating a far more extensive use of oil asphalts than I had suspected, and of the excellent results which appear to have been obtained therefrom, I would not feel justified at the present time in recommending the entire exclusion of this material.

Mr. Clifford Richardson, the expert under whose direction are prepared the paving mixtures used by the companies under control of what is known as the Asphalt Trust, says that the work of the Atlantic Alcatraz Asphalt Co. came under his supervision in the last week of March, 1900, and that, during that year, very little, and during the following year none of the oil asphalt was used by that company in Manhattan. He does not know what material was used by the Asphalt Construction Co.

Mr. A. W. Dow, the expert in charge of asphalt pavements in the District of Columbia, in speaking of oil asphalt, says: "I myself am perfectly satisfied that some of these asphalts made from distilling oils are satisfactory in every way for paving. . . . The great trouble with this class of asphalts is that they are manufactured by about every little oil refinery in California. There are but two that I know of who know anything at all about what is required for paving, and if the others happen to strike it, it is more good fortune than good management."

It appears to have been conclusively shown that very satisfactory pavements can be made from oil asphalts, and that such pavements have been laid in this City during the last six years with entire satisfaction. The oldest of these pavements are in the Borough of Brooklyn, and many of those in the Borough of Manhattan are in streets subject to considerable traffic, even though they are situated "above Fifty-ninth street." I believe that, as a rule, the hard, natural asphalts are safer, because in their treatment the production of a bituminous cement for paving is the main object, while in the case of oils there are other products, to obtain which the quality of the residue used for paving may sometimes be sacrificed.

Although every possible precaution should be taken to prevent the use of unstable materials and asphalt which may be simply a residue after the distillation of lighter oils, without regard to its adaptability to street paving purposes, the wisdom of the exclusion of material known to have given satisfactory results may be questioned. The recommendation that this should be done was, so far as I was concerned, made without an appreciation of the extent to which oil asphalt has already been used.

There have lately appeared in the public press extracts from a report of the Chief Engineer of Highways of the Borough of Manhattan, in which it is stated that the report recommending the exclusion of all oil asphalts was drawn by me. This statement is scarcely correct. In the report as drafted by me, and in the amendment of the specifications as first proposed, there was no reference whatever to oil asphalts. It was only at the last meeting of the Committee and just before the report was submitted, that the insertion of this clause was proposed. The suggestion came from another engineer who had attended the meetings at the invitation of the Borough President, a gentleman for whose opinion I entertain the highest respect, and whose judgment in questions relating to asphalt paving I consider excellent. I have had some correspondence with him upon the subject since, and he appears to hold the same opinion that he did at that time. As the Borough President has not quoted him, I do not feel at liberty to do so.

To specify the qualities of an oil asphalt which will make a durable and acceptable pavement, and those which will render such a result doubtful, and to define, in a specification for asphalt paving, requirements which will establish a satisfactory standard, is exceedingly difficult, if not impossible. The Committee on Road Materials of the American Society for Testing Materials now has this question under consideration, and the sub-committee on the testing of asphalt for paving hopes to be able to formulate some tests which will accomplish this result. One member of that committee, who is a recognized authority on asphalt paving, has told me that he has about come to the conclusion that the safest way to describe what material is acceptable is to name the brands produced by those who know the requirements of a good paving cement and have demonstrated their ability to produce such material of a uniform quality.

In my opinion, there is little hope of preparing a specification for asphalt paving which will not be the subject of attack and dispute. We are dealing with a group of materials which are not sharply defined, either physically or chemically. New deposits and new processes are continually being discovered, and if any of them are

excluded, favoritism is alleged. An asphalt controversy has been in progress since bituminous pavements have been laid, and it is more than probable that it will continue indefinitely.

GAS AND ELECTRIC DRIVEN AIR-COMPRESSORS.

By GEORGE H. GIBSON.

Power-driven air compressors are usually provided with either belting or gearing for the transmission of power to the compressor shaft. However, belting requires a great deal of floor space and is a source of constant expense, both on account of lost power and the cost of maintenance. Gearing is more compact and more slightly than belting, but is noisy and even more subject to wear and friction.

Two machines recently built by the Laidlaw-Dunn-Gordon Co. seem to solve this question of power transmission. The first is a double-end, two-stage compressor built for direct connection to a gas engine operating at 170 r.p.m. The cylinders of this machine are 21 and 12 in. in diameter, with a 12-in. stroke, giving a displacement of 810 cu. ft. per minute against 100 lb. air pressure. The prime mover will be a 150-h.p. Crossley gas engine, manufactured by the Power & Mining Machinery Co. The type of frame used in this compressor was selected to harmonize with the Crossley gas-engine design, and to render the entire outfit more compact than if the ordinary duplex arrangement had been used. The crank shaft of the compressor is extended on one side and coupled to the gas engine shaft, a heavy fly-wheel being placed between the main bearings of the gas engine and the compressor. The cranks of the compressor are arranged at an angle of 90 deg. with each other, in order to equalize the torque.

The second compressor was built for the General Electric Co. to be driven by a 150-h.p. motor, the armature of which is mounted directly on the compressor shaft. The air cylinders of this machine are 18 and 11 in. in diameter, respectively, with a common stroke of 24 in., the entire outfit operating at a speed of 120 r.p.m. and giving a displacement of about 850 cu. ft. per min. against 100 lb. air pressure. The frame construction is of the Laidlaw-Dunn-Gordon standard rolling mill type, the motor being placed directly between the frames.

These machines are fitted with the Cincinnati valve-gear, the essential feature of which is the mechanical closing of the discharge, as well as the mechanical control of both the opening and the closing of the suction, this feature resulting in perfectly quiet action and good efficiency at speeds which would be impossible with the ordinary poppet or semi-mechanical valve gears.

The stumbling block in the way of high compressor speeds heretofore has been the lack of a means for controlling positively these three constant points in the compression cycle without destroying the flexibility of the machine by also fixing the point of opening of the discharge. The real importance of this point will be realized when it is considered that for good efficiency the discharge valve must continue to give a fair opening up to the very end of the stroke, and must then close before the return stroke has progressed more than a small fraction of its total length. The smaller the fraction the better, in fact. Roughly speaking, to prevent serious loss by back blowing, the discharge valve should close in about one-fortieth of the time occupied by a revolution, and as the poppet valve must have some weight in order to stand the impact resulting from this sharp action, it will be seen that considerable force is required to overcome the inertia due to this weight and accomplish the necessary travel in the almost inconceivably short time available.

On the other hand, numerous ways have been designed for accomplishing mechanically both the opening and closing of the discharge valves, but these constructions either involve a fixed point of opening of the discharge, allowing the machine to run efficiently at only one pressure, or else they involve complication in the way of automatic release gears.

The Cincinnati gear retains the elasticity and simplicity of a poppet discharge opening, the opening of the discharge being the only variable point in the cycle, and at the same time controls mechanically the fixed points of discharge closing and suction opening and closing. This point is explained at some length, in order that it may be understood just why Cincinnati machines can be directly connected to motors or gas engines having fairly high speeds, as described above, without the sacrifice of efficiency which would accompany the use of other gears on the same service.

BUSINESS NOTES.

The statement that continuous concrete mixers were never used on government work is plainly disproved by the following telegraphic order to the Drake Standard Machine Works, of Chicago, from Major Gallagher, deputy general purchasing office of the Isthmian Canal Commission: "Please ship as soon as possible to Isthmian

Canal Warehouse Number Twenty-Six, corner Twenty-eighth Street and Thirteenth Avenue, New York, 1 No. 2 and 3 No. 3 concrete mixers with feed and measuring boxes, as per page 11 your catalogue C, to be securely packed for ocean shipment and forwarded from Chicago not later than 30th instant. Price for No. 2, \$1,285 and for No. 3 \$1,135 each, or \$4,690 for all four. Formal order and shipping instructions by mail to-day acknowledge."

It is stated that the Niles-Bement-Pond Co. has arranged to take over the business of the John Bertram & Sons Co., Ltd., of Port Dundas, Ont., and will build large additions to the Bertram plant. It is understood that one reason for this purchase is the extension of the foreign business of the company, which can be conducted more conveniently from Canada than the United States.

The Monash-Younger Co., 208 South St., Chicago, has brought out a new duplex air valve for radiators. It is much like the company's present duplex valve, having a separate air tube conducting the air from the radiator to the top of valve. The new feature is a four-way draining attachment which extends from the valve nipple into the radiator, thereby clearing the valve of sediment and condensation water and preventing the flooding of floors.

The National Fire-Proofing Co. of New York and Pittsburg is putting up, in record-making time, a six-story 425 x 125-ft. hotel at Atlantic City, N. J. On June 17 the ground was vacant, while on Nov. 1 the completed fireproof structure will be turned over to the owners for decoration. Hollow tile with pebble-dashed exterior finish is used for the outer walls, while the structural features inside are largely of hollow tile, reinforced with steel bars.

The firm of Pepper & Register, engineers and general contractors, has been dissolved and all its outstanding contracts and obligations have been assumed by the firm of A. L. Register & Co. The offices of the latter will be at 112 North Broad St., Philadelphia. Mr. David Pepper, Jr., of the old firm, and Mr. John R. Bowie have formed a partnership under the name of Pepper & Bowie, with offices in the Land Title Bldg., Philadelphia. It will carry on an engineering and general contracting business.

The London branch of the Buffalo Forge Co. has closed an order for seven independent heating and ventilating plants for the Portsmouth dock yards. Specially designed fans and heaters will be used.

The Robins Conveying Belt Co., 21 Park Row, New York, is finishing up several large shipments of belt conveyors for Belgian lead works. It is constructing a conveyor and elevator for the Union Fuel Co., San Francisco, and two belt conveyors for the Cranberry Furnace Co. The storing and reclaiming bridge which the company is erecting at Milwaukee for the Smet-Solvay Co. is practically completed.

PERSONAL NOTES.

Mr. F. E. Watson has been appointed engineer of maintenance of way, bridges and buildings on the Panama R. R.

Mr. Joseph Ramsey, Jr., president of the Wabash R. R., has returned to this country from a protracted visit to Europe.

Mr. George L. Dillman, who has been consulting engineer of the Western Pacific Ry. since its inception, has resigned that position.

Mr. J. B. Bishop, a well known author and editor, of New York, has been appointed executive secretary of the Isthmian Canal Commission.

Mr. Robert H. Moth, city engineer and superintendent of water-works of Kenosha, Wis., for the last six years, has resigned on account of ill health.

The Isthmian Canal Commission states that Mr. W. E. Dauchy has not resigned his position of assistant engineer on its staff, as was announced a short time ago.

Mr. Richard Mather has severed his connection with the Chicago, Burlington & Quincy R. R. to become assistant engineer with the Erie R. R. on its proposed line between Cuba and Hunts.

Mr. George P. Carver, of Beverly, Mass., was the author of the article on the dams of the United Shoe Machinery Co. published last week. His name was omitted from the article through an oversight.

Mr. Charles S. Gowen has resigned his position as division engineer of the Croton Aqueduct Commission. He has been in charge of the work on the Croton dam, now practically completed, for a number of years.

M. Philippe Bunau-Varilla, formerly chief engineer of the Panama Canal Co., is visiting the country in order to present his plans for a ship canal to the Board of Consulting Engineers of the Isthmian Canal Commission.

Mr. B. H. Warren retired on Sept. 1 from the presidency of Allis-Chalmers Co. It is understood that he will become the head of a new engineering and contracting company in New York, which will have many influential interests behind it.

Mr. A. R. Fillebrown, assistant engineer on the Pennsylvania R. R., died in Sunbury, Pa., recently. He was

a graduate of Lafayette College and entered the Pennsylvania service in 1883, where he has since remained, save for one year on government work.

Mr. Walter S. Woods has been appointed city engineer of La Crosse, Wis., where he has been first assistant in the engineering department for a number of years. He is a graduate of the University of Wisconsin and was engaged in railway work until his connection with the city of La Crosse in 1893.

The partnership hitherto existing under the firm name of Bates & Neilson has been dissolved by limitation, and Mr. Putnam A. Bates has succeeded to its business. His offices will be at 42 Broadway, New York, and he will give special attention to the preparation of plans for electrical installations and the application of electric power to machinery.

Mr. John M. Ewen, vice-president of the Fuller Construction Co., has been appointed consulting engineer of the new county building to be erected in Chicago. This appointment is made at the suggestion of the architects, who state that there will be many important technical questions arise on which an experienced builder can give valuable advice. The office carries a salary of \$15,000 a year.

Prof. Forrest R. Jones, lately professor of machine design in Sibley College, Cornell, and before that at the Worcester Polytechnic Institute, and Mr. Edward J. Kunze, a graduate of Cornell University, who has been making a specialty of oil and gas engines, have organized the Manhattan Automobile School at 315 West 96th St., New York, for the purpose of giving instructions in the care and operation of automobiles. Instruction will be given to owners and a regular school for chauffeurs will be conducted, which will give certificates of competency to properly trained men.

Mr. William R. Strickland has been appointed assistant to the secretary of J. G. White & Co., of New York. He is a graduate of the Massachusetts Institute of Technology, who was employed for some years in the designing departments of the Blake Pump Co., Buckeye Engine Co. and Case Mfg. Co. In 1900 he was engaged in hydraulic power development studies in Colorado, and after this work was completed was employed in locating a railway line for the Colorado Fuel & Iron Co., afterward doing similar work for several steam and electric roads in the same State. In 1902 he laid out a combined amalgamator, concentrator and arrester for the Lannius Machine Co. and the next year was appointed locating engineer on the New York Central R. R., in which capacity he supervised extension, double-tracking and grade revision schemes. For the last year he has been an assistant engineer in the maintenance of way department of that company, in charge of the correspondence of all the divisions respecting the repair and construction of buildings.

The Executive Council of British Columbia made the following interesting report a few months ago: "The undersigned has the honor to report that Messrs. Waddell & Hedrick, consulting engineers of Kansas City, Mo., were engaged by the Government of British Columbia to design and supervise the construction and completion of a combined railway and traffic bridge, with stone and concrete piers and steel superstructure, over the Fraser River, at New Westminster; that the engineering questions arising in both designing and carrying to completion this extensive and important structure presented exceptional difficulties, demanding engineering ability of the highest order; that the structure was completed in accordance with the drawings and specifications at a cost of about \$1,000,000, without alterations or mishaps and with extreme accuracy and attention to detail, bearing testimony to the ability and integrity of Messrs. Waddell & Hedrick, and that they are worthy of a distinguished recognition of their services, begs to recommend that His Honor, the Lieutenant Governor, will be pleased to convey the thanks and appreciation of the Government of the services rendered by them." This report was signed by the Chief Commissioner of Lands and Works and endorsed by the presiding member of the Council.

TRADE PUBLICATIONS.

The great variety of cranes now necessary in industrial works is well shown in the new 100-page catalogue of the Northern Engineering Works, 20 Chene St., Detroit. The range from the enormous affairs for outdoor use to the small apparatus running on the flanges of overhead beams is very great, while the variation in methods of operation from hand power to five electric motors is also wide. This book contains illustrated descriptions of the types that can be called standard, and many views of shops and yards containing them are given.

Part 5 of the general catalogue of Warren Webster & Co., Camden, N. J., is a very good description of the Webster system of steam circulation without pressure for heating purposes. This is now used in nearly 2,000 buildings in all parts of the country, illustrations of many of them being given in the catalogue.

The design and manufacture of motors for small power purposes has long been one of the specialties of

the Crocker-Wheeler Co., Amper, N. J., and its new bulletin of such apparatus is correspondingly valuable. The lines described are built to give from 1/4 to 3 h.p. and for direct, belt or gear drive. They are fitted with end shields, which permit their being made dust-proof, and are adapted for wall or ceiling suspension. The bulletin shows them applied to machine tools, ice cream freezers, centrifugal pumps, pipe-threaders, traveling hoists, printing and electrotyping machinery and other uses.

Blast holes are now often sunk by drilling machines, modified from those used in drilling for water, gas and oil and for prospecting. The Cyclone Drilling Machine Co., Orrville, O., has been making a specialty of such equipment and has brought out a machine, called the "Cyclone Contractor," particularly for it. It is adapted for drilling 1/4 to 6-in. holes, although the 3-in. size is generally found best, and is fully described in a pamphlet just issued by the company for the use of contractors who have to break down material for steam shovels and similar purposes.

An enormous variety of materials ranging from steel structures to rugs, carpets and office furniture has been accumulated by the Chicago House Wrecking Co., 35th and Iron Sts., Chicago, at the Louisiana Purchase Exposition. The demolition of the exposition has been in charge of this company, which is now selling off the lumber, building materials, electrical supplies, fire apparatus, machinery, piping, hardware, household articles and merchandise of every sort which was left when the Fair was closed. The catalogue of the spoils is a book of 440 pages and about everything used in ordinary building and contracting work is listed in it.

The "Valve World" for July is a special jubilee number in commemoration of the fiftieth anniversary of the Crane Company. An interesting account of the remarkable development of the business of this company is presented, from its inception in 1855 by R. T. Crane in the form of a small brass foundry in an obscure corner of Chicago, to its present size with nine large factory departments and 24 branches in various cities of the United States. The first week in July was given over to festivities among the employees, including a jubilee picnic, which is illustrated in the special edition.

The Russell Engine Co., Massillon, O., has published a number of loose sheets of engravings of its new self-oiling engine. In making the designs the aim has been to construct wearing surface and arrange for the lubrication so as to render it unnecessary to pay any attention to the engine, a feature which is desirable in office buildings and isolated plants generally. The new design has been worked out for a variety of simple and compound types.

The Holly system of underground steam distribution, first installed in Lockport, N. Y., in 1877, is now used in many cities. The American District Steam Co., of Lockport, which builds the system, has unusual opportunities for practically testing all improvements that are suggested, and in consequence its new catalogue contains much original information on the details of heating from central stations. It explains every feature of construction of such systems, and gives plans of the heating mains in eight cities.

The "Radialax" coal cutter described in a new catalogue of the Ingersoll-Sergeant Drill Co., 11 Broadway, New York, is essentially a longstroke rock drill with a special mounting to adapt it to coal mining work. It is intended mainly for shearing and entry driving. The cut has a maximum depth of 8 ft. from the face, and its width diminishes from 4 1/2 in. at the face to 2 1/2 in. at the bottom.

Regulating and reversing controllers for use with both direct and alternating-current motors driving elevators, machine tools, cranes and similar apparatus are described in detail in Circular 1108 of the Westinghouse Electric & Mfg. Co. A number of types of these controllers are made, and their uses are explained at considerable length.

The Wood Drill Works, Paterson, N. J., which supplied many of the rock drills used on the work at Henderson's Point, where the great blast was fired which was recently described in this journal, has issued a valuable catalogue of such machines. These are made in nine sizes and can be mounted in various ways. The details of the design are fully explained and the pamphlet gives considerable information on the selection and maintenance of drills.

The general features of the direct-current lighting and power generators made by the Crocker-Wheeler Co., Amper, N. J., are described in its bulletin 53. These are all of the direct-connected type, designed to meet the tests recommended by the Am. Inst. E. E. and the standard speeds of most engine builders. The pamphlet explains the design of the important parts and contains illustrations of typical installations of units varying from 60 to 600 kw. in size. The company has also republished in attractive form a series of papers on the electric drive at the McKees Rocks shops of the Pittsburgh & Lake Erie R. R., written for the "American Engineer" by Mr. Roy V. Wright.

Hydraulic rams, when properly constructed, are very useful for certain classes of work, and the Rife hydraulic engine, which is an improved ram, accomplishes much that was beyond the capacity of the older types of apparatus. It is fully described in a catalogue published by the Power Specialty Co., 111 Broadway, New York.

A concise description of dredging buckets and some of the machines by which they are operated is given in a booklet from the Hayward Co., 97 Cedar St., New York. The buckets are made in two types, the orange-peel and the clamshell. The former are regularly manufactured in four grades of strength and the latter in five, one of them being specially designed for handling iron ore and other material too hard and heavy for a dredging bucket to work in. The company also makes scoop, bottom-dump and turnover buckets for handling coal, stone, sand and similar materials and is prepared to build skid excavators, floating dredges, traveling derricks, coal handling machinery and other plants in which its line of buckets is used. Illustrations of such equipments are given in the booklet.

The demand for information concerning its motors built specially for direct-driven machinery has led the Electro-Dynamic Co. of Bayonne, N. J., to revise its circulars and issue a "B" series. The "Interpole" variable speed motor is commonly built with a speed range of 2:1, 3:1 or 4:1, the last being as wide a variation as there is any call for, although motors for a greater range can be built if desired. Within the range for which the motor was built the speed remains constant under varying loads. The many unique features of construction and operation of these machines are explained in the circulars in detail. The new circulars also explain the details of the company's constant-speed motors and generators, which are built in many sizes.

Since the construction and occupation of its new shops the Ball Engine Co., Erie, Pa., has been redesigning and enlarging the range of its output and is now prepared to build single-valve engines of 50 to 700 h.p. and Corliss engines of 200 to 1,200 h.p. The new designs are fully explained in a catalogue just issued. The side-crank type has been adopted for both horizontal and vertical engines, as it avoids an overhanging wheel and the necessity for three bearings. A shaft governor is used on both single valve and Corliss engines, and the company finds it difficult to speak of its merits with moderation. The centrifugal force of the weight is resisted directly by a spring and not transmitted through any bearings. In the Corliss engine the Armstrong non-detaching valve gear is used, by means of which a positive movement is obtained which keeps the admission valves motionless at least half the time. The catalogue describes these and all other important details at length.

Coal handling machinery for boiler plants, coaling stations, gas companies, coal yards and similar plants has been a specialty of the C. W. Hunt Co., West New Brighton, N. Y., for over thirty years, and its new catalogue of such equipment accordingly represents successful apparatus. It describes at length different towers and masts for unloading coal from vessels, various buckets and railways, the Hunt coal cracker, the conveyor system which is used for coal and ashes in power plants, scales and weighing hoppers, screens, valves, hoisting blocks, rope and other apparatus and supplies. The catalogue is particularly noteworthy for the information it furnishes concerning those parts of the different classes of apparatus in which the wear is likely to be greatest.

Contractors and owners of industrial plants who are not following the development of mining and colliery equipment are likely to miss useful knowledge. For example, the Sullivan Machinery Co. of Chicago has recently combined the most desirable features of the Mitchell and Wilson automatic cross-over dump in a new apparatus described in its bulletin 48E. This is built primarily to load into railroad cars the coal from drift or slope mines. On reaching the tippie the cars are sent separately to the dump. The car is caught, dumped and switched to the return track automatically. It is manifest that such apparatus is useful in many other plants.

The Crane Co. of Chicago has recently issued a folder describing a new automatic exhaust relief valve. The valve disk has a water seal around the edge and a dash-pot is placed over it to keep it from chattering. When it is desired to run non-condensing the disk can be raised permanently.

The hoisting and conveying machinery used in a number of larger power plants is described in bulletin 12 of the Robins Conveying Belt Co., 21 Park Row, New York. These installations employ belt conveyors and their general arrangement is entirely unlike the older systems using buckets. The illustrations give the clearest outlines of the plants that have yet been published.

Owners of stores and shops who are troubled with defective electric lighting will find much interesting information on the subject of interior illumination in a book issued by the American Metal Stamping Co., Germantown, Philadelphia. It describes the light-balancing selective diffuser ceilings developed by the company, and Mr. W. D'A. Ryan, of the General Electric Co., whose work along this line is well known.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS AND
MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Albertville, Ala.—See Power Plants, Gas and Electricity.

Phoenix, Ariz.—The Verde Water & Power Co. (Benj. C. Sheldon, Secy.) is having surveys made for the irrigation reservoir, to be constructed near Phoenix. John Bogart, 16 Exchange Pl., N. Y. City, N. Y., is the engineer in charge.

Aspen, Colo.—The Aspen Water Co. on Aug. 28 made a proposition to the City Council offering to sell its system for \$125,000 or if its franchise is extended 20 years it will cancel a debt owed by the city and furnish the city with water at \$1.00 per year and make a reduction to its patrons of 15 per cent. It is also reported that the installation of a municipal system is under consideration and will be voted on at an election to be held Sept. 11.

Trinidad, Colo.—The Special Com. appointed to investigate the proposition to purchase Lake North as a town reservoir site, it is stated, has reported to the City Council in favor of said plan. It is reported that it will cost nearly \$1,000,000 to bring water from the lake to Trinidad, and that gravity pressure will be used.

Montrose, Colo.—The following are the bids opened Aug. 28 at the office of the Engineer, U. S. Reclamation Service, Montrose, for constructing about 8 miles of main distributing canal, involving the excav. of 525,000 cu. yds. of material and the placing of 20,000 cu. yds. of concrete masonry for the conveyance and partial distribution of 1,300 cu. ft. of water per second from the mouth of the Gunnison Tunnel, near Cedar Creek, to a point on the Uncompahgre river, 9 miles south of Montrose: (a) Orman & Crook, Pueblo, Colo.; (b) Saml. Treas, Montrose; (c) Smith Bros., Montrose; (d) Knowlton & Bollen Constr. Co., Ft. Collins, Colo.; (e) Wm. S. Henderson, Montrose:

Division 10—	a	b
11,000 cu. yds. excav., class 1.....	\$0.17	\$0.30
16,000 cu. yds. excav., class 2.....	.30	.40
10,000 cu. yds. excav., class 3.....	.37	.10
5,000 cu. yds. excav., class 4.....	.75	1.10
2,000 cu. yds. overhaul.....	.02	.04
200 cu. yds. refilling.....	.50	1.00
1,100 sq. yds. paving.....	2.00	3.00
50 cu. yds. dry rubble masonry.....	5.00	3.00
1,800 cu. yds. concrete, class 1.....	9.00	16.00
1,800 cu. yds. concrete, class 2.....	7.50	10.00
250 lin. ft. 36-in. pipe laid.....	2.00	1.00
Furnishing and placing steel for concrete reinforcement.....		
38,000 lbs. R. R. rails, 40 lb. per yd.....	.05½	.08
41,000 lbs. R. R. rails, 16 lb. per yd.....	.06	.07
Total.....	\$51,460	\$77,890

Division 13—	a	b
7,600 cu. yds. excav., class 1.....	\$0.17	\$0.30
7,000 cu. yds. excav., class 2.....	.33	.40
14,000 cu. yds. excav., class 3.....	.40	.60
8,000 cu. yds. excav., class 4.....	.75	1.10
2,000 cu. yds. overhaul.....	.02	.04
50 sq. yds. paving.....	2.00	3.00
200 cu. yds. dry rubble masonry.....	5.00	5.00
1,000 cu. yds. concrete, class 1.....	9.00	19.00
50 cu. yds. concrete, class 2.....	7.50	17.00
300 lin. ft. tunnel, class 1.....	33.00	20.50
200 lin. ft. tunnel, class 2.....	56.75	22.50
Total.....	\$46,865	\$53,830

Division 14—	a	b
3,000 cu. yds. excav., class 1.....	\$0.17	\$0.30
3,000 cu. yds. excav., class 2.....	.33	.40
4,000 cu. yds. excav., class 3.....	.40	.60
3,000 cu. yds. excav., class 4.....	.75	1.10
1,000 cu. yds. overhaul.....	.02	.04
50 cu. yds. refilling.....	.50	1.00
100 sq. yds. paving.....	2.00	3.00
1,000 cu. yds. dry rubble masonry.....	5.00	5.00
800 cu. yds. concrete, class 1.....	9.00	19.00
20 cu. yds. concrete, class 2.....	7.50	17.00
100 lin. ft. 36-in. pipe, to be laid.....	2.00	1.00
200 lin. ft. tunnel, class 1.....	33.00	20.50
200 lin. ft. tunnel, class 2.....	56.25	22.50
Total.....	\$35,995	\$37,430

Division 15—	a	b
5,000 cu. yds. excav., class 1.....	\$0.18	\$0.65
6,000 cu. yds. excav., class 2.....	.33	.80
10,000 cu. yds. excav., class 3.....	.40	1.00
5,000 cu. yds. excav., class 4.....	.80	1.25
2,000 cu. yds. overhaul.....	.02	.04
100 cu. yds. refilling.....	.50	1.00
100 sq. yds. paving.....	2.00	3.00
100 cu. yds. dry rubble masonry.....	5.00	5.00
700 cu. yds. concrete, class 1.....	9.00	19.00
50 cu. yds. concrete, class 2.....	7.50	17.00
500 lin. ft. tunnel, class 1.....	33.00	20.50
500 lin. ft. tunnel, class 2.....	57.25	22.50
Total.....	\$63,470	\$60,930

Division 18—	a	b
9,000 cu. yds. excav., class 1.....	\$0.14	\$0.18
6,000 cu. yds. excav., class 2.....	.30	.35
13,000 cu. yds. excav., class 3.....	.36	.45
10,000 cu. yds. excav., class 4.....	.75	.95
2,000 cu. yds. overhaul.....	.02	.02
1,200 cu. yds. refilling.....	.50	.50
1,500 sq. yds. paving.....	2.25	2.00
700 cu. yds. dry rubble masonry.....	5.50	6.00
1,400 cu. yds. concrete, class 1.....	9.00	11.00
700 cu. yds. concrete, class 2.....	7.50	8.00
200 lin. ft. 24-in. pipe, to be laid.....	1.75	.88
Total.....	\$41,305	\$48,086

Division	a	b
15,000 cu. yds. excav., class 1.....	\$0.14	\$0.24
5,000 cu. yds. excav., class 2.....	.30	.30
9,000 cu. yds. excav., class 3.....	.37	.45
5,000 cu. yds. excav., class 4.....	.70	.95
3,000 cu. yds. overhaul.....	.02	.02
200 cu. yds. refilling.....	.50	.50
900 sq. yds. paving.....	2.00	2.00
50 cu. yds. dry rubble masonry.....	5.00	6.00

700 cu. yds. concrete, class 1.....	8.00	10.00
20 cu. yds. concrete, class 2.....	7.00	8.00
300 lin. ft. 24-in. pipe, to be laid.....	1.75	.88

Total.....	\$18,905	\$23,584
Division 21—	a	c
50,000 cu. yds. excav., class 1.....	\$0.14	\$0.14
18,000 cu. yds. excav., class 2.....	.30	.25
35,000 cu. yds. excav., class 3.....	.37	.40
10,000 cu. yds. excav., class 4.....	.70	.90
10,000 cu. yds. overhaul.....	.02	.02
200 cu. yds. refilling.....	.50	.75
400 sq. yds. paving.....	2.00	1.25
50 cu. yds. dry rubble masonry.....	4.50	.75
50 cu. yds. concrete, class 1.....	8.00	5.00
50 cu. yds. concrete, class 2.....	7.00	5.00
400 lin. ft. 36-in. pipe, to be laid.....	2.00	.25
200 lin. ft. 24-in. pipe, to be laid.....	1.75	.20

Total.....\$35,575 \$36,027 \$42,322
Orman & Crook, of Pueblo, Colo., submitted the only bid on Divisions 11, 12, 16, 17 and 19 at the following prices:

Division 11—6,000 cu. yds. excav., class 1, 15 cts. per cu. yd.; 4,000 cu. yds. excav., class 2, 30 cts.; 15,000 cu. yds. excav., class 3, 37 cts.; 6,000 cu. yds. excav., class 4, 75 cts.; 5,000 cu. yds. overhaul, 2 cts. per cu. yd.; 100 cu. yds. refilling, 50 cts. per cu. yd.; 800 sq. yds. paving, \$2 per sq. yd.; 900 cu. yds. concrete, class 1, \$9 per cu. yd.; 700 cu. yds. concrete, class 2, \$7.50 per cu. yd.; 200 lin. ft. 24-in. pipe, to be laid, \$1.75 per lin. ft.; furnishing and placing steel for concrete reinforcement, 15,000 lbs. railroad rails, 40 lbs. to yd., 5½ cts. per lb.; 16,000 lbs. railroad rails, 16 lbs. to yd., 6 cts. per lb. Total, \$29,385.

Division 12—5,000 cu. yds. excav., class 1, 15 cts.; 4,000 cu. yds. excav., class 2, 30 cts.; 11,000 cu. yds. excav., class 3, 37 cts.; 6,000 cu. yds. excav., class 4, 75 cts.; 1,000 cu. yds. overhaul, 2 cts.; 600 cu. yds. refilling, 50 cts.; 1,000 sq. yds. paving, \$2; 100 cu. yds. dry rubble masonry, \$5; 700 cu. yds. concrete, class 1, \$9; 150 cu. yds. concrete, class 2, \$7.50; 100 lin. ft. 24-in. pipe, to be laid, \$1.75. Total, \$20,940.

Division 16—25,000 cu. yds. excav., class 1, 18 cts.; 25,000 cu. yds. excav., class 2, 33 cts.; 32,000 cu. yds. excav., class 3, 40 cts.; 10,000 cu. yds. excav., class 4, 80 cts.; 5,000 cu. yds. overhaul, 2 cts.; 500 cu. yds. refilling, 50 cts.; 1,200 sq. yds. paving, \$2; 800 cu. yds. dry rubble masonry, \$5; 3,900 cu. yds. concrete, class 1, \$9; 2,500 cu. yds. concrete, class 2, \$7.50; 100 lin. ft. 36-in. pipe, to be laid, \$2; 100 lin. ft. 24-in. pipe, to be laid, \$1.75; furnishing and placing steel for concrete reinforcement, 53,000 lbs. railroad rails, 40 lbs. to yd., 5½ cts.; 57,000 lbs. railroad rails, 16 lbs. to yd., 6 cts. per lb. Total, \$100,860.

Division 17—6,000 cu. yds. excav., class 1, 15 cts.; 6,000 cu. yds. excav., class 2, 30 cts.; 20,000 cu. yds. excav., class 3, 37 cts.; 8,000 cu. yds. excav., class 4, 75 cts.; 30,000 cu. yds. overhaul, 2 cts.; 1,700 cu. yds. refilling, 50 cts.; 2,300 sq. yds. paving, \$2.25; 300 cu. yds. dry rubble masonry, \$5.50; 1,100 cu. yds. concrete, class 1, \$9; 600 cu. yds. concrete, class 2, \$7.50; 200 lin. ft. 24-in. pipe, to be laid, \$1.75. Total, \$39,125.

Division 19—11,000 cu. yds. excav., class 1, 14½ cts.; 6,000 cu. yds. excav., class 2, 30 cts.; 18,000 cu. yds. excav., class 3, 37 cts.; 10,000 cu. yds. excav., class 4, 75 cts.; 30,000 cu. yds. overhaul, 2 cts.; 100 cu. yds. refilling, 50 cts.; 200 cu. yds. dry rubble masonry, \$5; 1,100 cu. yds. concrete, class 1, \$9; 50 cu. yds. concrete, class 2, \$7.50. Total, \$29,480.

Danbury, Conn.—It is stated that plans are being prepared for a distributing reservoir to cost about \$18,000, which will facilitate the distributing of the water from Boggs Pond and the proposed new reservoir. W. S. Morton, of Hartford, is the Consulting Engr.; Mr. Olmstead is Chmn. of the Water Com. of the Common Council.

Wilmington, Del.—The following are the totals of the bids received Sept. 4 for the construction of a 35,000-gal. reservoir (Theo. A. Leisen, Engr. Water Dept.): Jeremiah T. Fruch & Co., Glen Falls, N. Y., \$161,115; Jas. Malloy & Co., Wilmington, Del., \$179,800; J. P. McNichol & Bro., Philadelphia, Pa., \$184,999; Manufacturers' Contr. Co., Wilmington, Del., \$187,000; Bunting Constr. Co., Long Island City, N. Y., \$199,000, and West Newcomb Co., Philadelphia Pa. \$199,673.

Quincy, Fla.—See "Power Plants, Gas and Electricity."

Daytona, Fla.—Cromwell Gibbons, of Jacksonville, and J. Hall Brumby, of De Land, have petitioned the City Council for a 30-year franchise and have offered to put in 50 hydrants for fire protection at a cost to the city of \$2,500 a year during the existence of the franchise. At the end of 30 years the city to have the privilege of buying the water works.

Many of the taxpayers are said to be in favor of issuing \$60,000 bonds and installing a municipal water works.

Barnesville, Ga.—J. A. Blalock, City Clk., writes that it proposed to purchase about 4,000 to 5,000 ft. 3 or 4-in. pipe.

Milledgeville, Ga.—Bids will be received until Oct. 18 by the Bd. Trus. of the Georgia State Sanitarium, at Milledgeville, for constructing a water works and filtration plant, for the Sanitarium, as advertised in The Engineering Record; \$75,000 has been appropriated by the Legislature for this work.

Griffin, Ga.—The City Clk. writes that contract has already been let for the 8,000,000 gal. reservoir.

McLeansboro, Ill.—The reservoir which it is proposed constructing here will probably cost between \$7,000 and \$10,000. No engineer has been selected as yet and no date set for the receiving of bids. H. B. Pownell, City Clk.

Chicago, Ill.—It is reported that bids will soon be asked for furnishing 972 water meters.

Bids will be received until Sept. 13 by the Bd. Local Improvements (And. M. Lynch, Pres.) for constructing water services pipes in portions of 9 streets.

Lanesville, Ind.—The Lanesville Water Co., it is reported, has been incorporated by the people of the town, with a capital of \$6,000, for the purpose of building a water works system for the town.

Spencer, Mass.—The citizens are reported to have voted to have a survey made of the brook on Partridge Place, east of Shaw Pond, with a view to securing an additional water supply; also that a basin be erected around the pond and that a pipe be laid from Cider Mill

Pond, Lincoln St., to the mills on Valley St. N. E. Craig, City Engr.

Greenfield, Mass.—At a special fire dist. meeting Aug. 31, it was voted to raise an appropriation of \$15,000 for the purpose of completing the reservoir at Leyden and work incidental thereto.

Grand Rapids, Mich.—The only bid received and opened on Aug. 25 by the Bd. of Pub. Wks. for constructing a new stand pipe for the south end was submitted by the Chicago Bridge & Iron Wks., of Chicago, Ill., at \$10,428 for steel construction; \$3,000 extra for a pagoda top; \$2,900 extra for spiral stairs and balcony running to the top for a look-out.

Pipestone, Minn.—R. F. Weston, of La Crosse, Wis., is reported to have secured the contract for constructing water works for \$28,000.

Crookston, Minn.—The plans of F. W. Capellan, of Minneapolis, are stated to have been approved for water works to cost about \$30,000.

Montgomery, Minn.—It is stated that bids will be received until Sept. 16 by F. J. Svejda, City Recorder, for a steel water tower and tank with short pipe line connecting with present water works. J. J. Flather, Engr., Minneapolis.

East Grand Forks, Minn.—The plans of F. W. Chapellen, of Minneapolis, have been accepted by the City Council, the cost being estimated at \$30,000. The plans provide for a pumping station on Red Lake River, to be equipped with 2 pumps. An ordinance has been passed by the City Council providing for the sale of water works bonds, and as soon as bonds are sold, it is stated, that bids for the construction of the plant will be asked.

Minneapolis, Minn.—A Com. of 16 of which B. F. Nelson, Chmn. Pub. Affairs Com., is a member, has been appointed to confer with the government engineers on Sept. 12 on the Mississippi River reservoir problem.

Comfrey, Minn.—It is reported that all bids for the water tower have been rejected and the matter will not be taken up again until next year.

Lucedale, Miss.—The Town Council is reported to have granted G. M. Luce and associates a franchise for water works.

Bassett, Neb.—The citizens are reported to have voted Aug. 26 to issue \$8,000 bonds for water works.

West Point, Neb.—The City Council, it is stated, has decided to build a stand pipe 15 ft. in diameter and 50 ft. high, to cost approximately \$2,400.

Lovelocks, Nev.—The town has bonded for \$12,000 for the purpose of installing a water system for fire purposes, and it is estimated that a pumping plant, tanks and mains can be put in for \$7,000.

Jarilla, N. M.—The Southwest Smelting & Refining Co., it is reported, has awarded the contract for 20 miles of pipe line to bring water from the Sacramento to a reservoir, which is to be constructed on Baird Hill, north of the town site, and is to have a capacity of 25,000,000 gals.

Roswell, N. M.—Plans and specifications are on file in the office of The Engineering Record, for constructing and completing earth embankments involving about 200,000 cu. yds. earthwork, and 150,000 cu. yds. overhaul at a point about 12 miles southwest of Roswell, bids for which are to be opened at the U. S. Reclamation Service, Roswell, Oct. 17, as advertised in The Engineering Record.

Crambury, N. J.—Bids will be received until Sept. 25 for furnishing material and constructing a system of water works for the Crambury Water Co. (C. C. Groves, Secy.) as advertised in The Engineering Record. Address all inquiries to W. E. Sexton, Engr., 1910 Market St., Philadelphia, Pa.; or Chas. S. York, Engr., Baltimore, Md.

New York, N. Y.—Plans for the high pressure fire system which is to be installed in the business district have, it is stated, been completed by I. M. de Varona, Ch. Engr. of the Dept. of Water Supply, Gas and Electricity. The Bd. of Estimate and Apportionment appropriated \$4,490,000 for this improvement about a year ago. One of the 2 pumping stations will be at Oliver, Water and South Sts. The other will be on city property, in Gansevoort St., fronting the North River. Each of these stations will be equipped with 5 multi-stage centrifugal pumps, capable of delivering 15,000 gals. a minute. This will give a total capacity for each station of 15,000 gals. a minute and a combined capacity for the 2 stations of 43,200,000 gals. a day. The pumps will be so designed that they may be regulated to deliver this quantity of water at any pressure desired between 100 and 300 lbs.

Troy, N. Y.—E. L. Grimes, Ch. Engr. Bureau of Water Supply, writes that specifications are being prepared for the construction of a filtration plant, to cost about \$297,850.

Buffalo, N. Y.—Bonds to the amount of \$1,000,000 are reported sold, of which \$500,000 will be used for improvements to the water works.

Sherburne, N. Y.—It is reported that one of the reservoirs of the village system was washed out by the cloud-burst of Sept. 3, causing a damage to the system to the extent of \$25,000.

Albany, N. Y.—The Bd. of Contract and Supply (Isidore Wachsman, Clk.) will receive bids Sept. 18 for constructing an intake for the filtration plant, estimated to cost \$30,000. It is to be of reinforced concrete 5 ft. in diameter.

Fillmore, N. Y.—Improvements amounting to about \$10,000 are to be made by the Fillmore Water Co. A 4-in. c-i. pipe, to supply the village with water, is being laid. Chas. Ricker, of Fillmore, is a member of the company.

Lakewood, N. Y.—The citizens, it is stated, have voted in favor of issuing \$30,000 bonds for the purpose of building a village water plant.

Newburg, O.—Bids will be received until Oct. 3 at the office of Fredk. W. Green, City Aud., for 50,000 water work bonds.

Cincinnati, O.—Plans and specifications are on file in the office of The Engineering Record for constructing filters, coagulation basins and clear-water reservoir, with pipe lines, valves, chambers and miscellaneous work in connection therewith, bids for which are to be opened by the Bd. Trus., Comrs. of Water Wks., on Sept. 29, as advertised in The Engineering Record.

McKeesport, Pa.—T. H. Verner, Supt. Water Dept., is reported to have presented to Council a report, detailing the cost of improvements to the water works, which will be about \$150,000. The improvements include extension of the large mains, along 5th Ave.

West Chester, Pa.—Harry Miller, of Wilmington, Del., it is stated, has secured the contract to lay 6,270 ft. 14-in. water main in West Chester.

Madison, S. D.—The County Bd., it is stated, intends sinking an artesian well 2,000 ft. and has \$5,000 available for the purpose.

Franklin, Tenn.—Specifications are on file in the office of The Engineering Record for constructing a municipal water works, bids for which are to be opened on Sept. 12, as advertised in The Engineering Record.

Clinton, Tenn.—See "Power Plants, Gas and Electricity."

Grand Saline, Tex.—Press reports state that bids are wanted until Sept. 19 for \$14,500 water works bonds.

Salt Lake City, Utah.—The Bd. Pub. Wks., Aug. 28, awarded the contract for the steel reinforcing bars for the Big Cottonwood conduit to the Salt Lake Hardware Co., Salt Lake City, at a total of about \$8,000. The contract calls for 240,000 lbs. of bars and the Salt Lake Hardware Co. bid 3.48 cts. per lb. for $\frac{3}{4}$ -in. Ransome Bessemer twisted bars in carload lots and 4.29 cts. per lb. for the same in less than carload lots; 3.20 cts. per lb. for $\frac{3}{4}$ -in. bars in carload lots and 3.02 cts. per lb. less than carload lots. The St. Louis Expanded Metal Fire Proofing Co. was the only other bidder, at 3.75 cts. per lb. for $\frac{3}{4}$ -in. bars in carload lots and 4.89 cts. per lb. for less than carload lots.

Walla Walla, Wash.—The City Council, it is stated, adopted the plans for a gravity water system prepared by Engr. O. E. Weile, of Spokane. Water is to be taken from Mill Creek, 15 miles east of Walla Walla, and carried through a pipe line to a reservoir of 5,000,000 gals. capacity, to be located on the city's land, about 2 miles east of the city.

Spokane, Wash.—Bonds amounting to \$450,000, it is stated, have been sold. It is reported that the proceeds are to be used to extend the water works.

Shoshone Agency, Wyo.—Bids will be received until Oct. 3 by the Comr. Indian Affairs, Dept. of the Interior, Washington, D. C., for constructing a water and sewer system at the Shoshone School. For further particulars apply to H. C. Wadsworth, Supt. Shoshone Agency.

Picton, Ont.—Engineers are making surveys and preparing plans for improvements which it is proposed making to the water works system. It is probable that nothing will be done in the matter this year, but that the plans will be submitted to the taxpayers in January, 1906, at the municipal election. The cost of the improvements will be between \$7,000 and \$10,000. G. M. Farrington, Mayor; H. B. Bristol, Chmn. Bd. Comrs.

Welland, Ont.—C. E. Steele is reported to be preparing plans for the construction of water works.

St. Boniface, Man.—The \$40,000 bonds recently issued are to be used to lay water mains in 22 new streets; also for boring new artesian wells. Theo. Bertrand, Secy.-Treas.; C. Goddard, Engr. in charge.

St. John, N. B.—D. Y. Stewart & Co., of Glasgow, it is stated, secured the contract to furnish 36-in. pipe at \$27.50 per ton.

Juarez, Mex.—The Governor has approved the plans of Nelson Rhoades, Jr., of Chihuahua, for the water system, which is to cost about \$65,000. It is stated that bids are to be asked for the construction very soon. The source of the supply is to be a well 120 ft. deep, to have a capacity of 2,000,000 gals. every 24 hrs. The pumping plant is to be operated by a gasoline engine and have a capacity of 500,000 gals. per day. The water is to be elevated into a tank on a steel tower 40 ft. high, the tank to have a capacity of about 300,000 gals. The pipe line is to be cast iron and will be nearly 6 miles long.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Montgomery, Ala.—It is reported that an ordinance has been passed appropriating \$4,000 for laying sanitary sewers in several streets.

Washington D. C.—The Connolly Constr. Co. has secured the contract for constructing sewers in the Dist. of Columbia, bids received Aug. 21, at \$34,195, and the Camden Iron Wks., of Philadelphia, Pa., the contract for the c. i. pipe and specials for the outfall sewage disposal system, bids received at the same time, at \$14,626.

All bids received Aug. 30 for constructing sewer from coal-testing plant on U. S. Reservation at Aqueduct Bridge, Roslyn, Va., to Potomac River, have been rejected. Capt. A. W. Butt, Q. M., U. S. A., in charge of depot.

Pensacola, Fla.—A Com. has been appointed to select an engineer to take charge of the sewerage and drainage work contemplated and also paving.

Sandwich, Ill.—E. L. Ingersoll, City Clk., writes that no contract will be entered into this year for sewerage.

East St. Louis, Ill.—The Bd. Local Improv. has decided to suspend action on the proposed improvement of 15th St. and Cleveland Ave. and will await the decision of the County Court before proceeding further in the matter of the outlet sewer.

Winnetka, Ill.—Engr. Frank A. Windes, of Winnetka, writes that the contract for constructing a sewage ejector station, including by pass, pipe, etc. (bids opened Aug. 10) has been awarded to F. G. Mortimer, of Glencoe, for \$14,600.

*Items marked thus give the names of parties awarded contracts.

Chicago, Ill.—The following are the bids opened on Aug. 31 by the Dept. of Pub. Wks. for constructing 1,220 ft. $\frac{3}{4}$ -ft. sewer in a portion of 63d St. (price given per lin. ft.): Nash Bros., 84 La Salle St., \$16.30; Wm. F. Healy, 88 Washington St., \$17, and Thos. J. Drury, 3232 Lowe Ave., \$16.40.

Bids will be received until Sept. 23 by the Dept. Pub. Wks. (J. M. Patterson, Comr.) for furnishing material and building approximately 1,370 ft. 14 x 20 ft. tunnel under the shoal water of Lake Michigan from and connecting with present tunnel now in Lawrence Ave. at shore line of Lake Michigan eastward, as advertised in The Engineering Record.

Bids will be received by the Dept. Pub. Wks. (J. M. Patterson, Comr.) until Sept. 12 for furnishing materials and constructing about 2,250 lin. ft. of 9 ft. internal diameter brick and concrete sewer in a portion of Paulina St.

Bids will be received until Sept. 13 by the Bd. Local Improv. (And. M. Lynch, Pres.) for constructing vitr. tile pipe sewers, with manholes and catch basins, in portions of 9 streets; also drains in portions of 7 streets.

Indianapolis, Ind.—Bids will be received until Sept. 15 by the Bd. Pub. Wks. (M. A. Downing, Pres.) for constructing a 10-in. pipe sewer in a portion of an alley.

Bids will be received until Sept. 11 by the Bd. Pub. Wks. (M. A. Downing, Pres.) for constructing a 12-in. pipe sewer in a portion of St. Clair St.

***Franklin, Ind.**—W. H. Malone, of Anderson, is reported to have secured the contract for constructing $3\frac{3}{4}$ miles of sewers for Franklin.

Wagoner, Ind. Ter.—The constructing of a storm sanitary sewer and laying 2,000 ft. of pavement has been postponed indefinitely.

Des Moines, Ia.—City Engr. Budd, it is stated, will at once prepare plans for a sewerage system and disposal plant for the district in Northwest Des Moines.

Carroll, Ia.—Bids will be received until Sept. 18 by Geo. A. Hoffman, City Clk., for constructing a sewage disposal plant, consisting of a sewage tank of about 80,000 gals. capacity, and 2 sand filter beds, each of about 13,000 sq. ft. area; A. Marston, Engr., Ames.

Marion, Mass.—It is stated that although the construction of sewers was voted down Aug. 25, a committee of 3 citizens has been appointed to consider the matter further and advise as to the best system.

Jackson, Mich.—About 3,600 ft. of 3 to 4½ ft. sewers are to be laid and a disposal plant with pumping station constructed. A. B. Stevens, City Engr.

Grand Rapids, Mich.—City Engr. L. W. Anderson is reported to have completed the report for a sewer to drain the 11th and 12th wards; he estimates the cost at \$85,000. He also estimates the cost of widening, deepening and straightening Silver Creek, at \$12,176.

Midland, Mich.—The citizens, it is stated, have voted in favor of bonding the city for \$8,333 to construct sewers in Butler and Hubbard sewer dist.

St. Paul, Minn.—The Bd. of Pub. Wks., it is reported, is about to petition the City Council to construct a sewer in Grand Ave. from Lexington to Griggs Sts. at \$1.61 per front foot and in Mt. Airy St. from Warren to the end of the present sewer at \$1.94 per front foot.

Virginia, Minn.—Bids will be received until Sept. 26 by the City Council for constructing a sanitary sewer in Sewer Dist. No. 3D. J. D. Lamont, Engr.; A. N. Thompson, City Clk.

***Winona, Minn.**—The following are the bids received Aug. 28 for constructing extension to the Washington St. storm water sewer, requiring 700 ft. ea. of 28 and 24-in. pipe, and 350 ft. ea. of 15 and 18-in. pipe, together with manholes, etc.: T. J. Green, \$4,784; John Regan, \$3,986 (awarded contract), and John Degnan, \$4,250.

***Jersey City, N. J.**—Bernard Gannon, 41 Graham St., secured the contract for constructing a sewer in Hudson Boule. and Sherman Pl. at 88 per cent. of the standard cost. The approximate quantities required are as follows, the prices given being 100 per cent. of the standard cost: 1,100 lin. ft. of 24-in. circular brick sewer, \$3.25 per lin. ft.; 400 lin. ft. of 18-in. vitrified pipe sewer, \$1.80 per lin. ft.; 500 cu. yds. of rock excav., \$2.50 per cu. yd.; 5 cu. yds. of brick masonry, \$6 per cu. yd., and 2 receiving basins, \$35 ea. Other bids received on this work were as follows: Chas. Ormsby, 3146 Hudson Boule., 110 per cent., and Chas. O'Neill, 92 Dwight St., 88 per cent. Philip Tumulty, Jr., 295 Monmouth St., secured the contract for constructing a sewer in Hudson Boule. and Terhune Ave., bids received Sept. 5 at 87½ per cent. of the standard cost. The approximate quantities required are as follows and prices given 100 per cent. of the standard cost: 1,560 lin. ft. 18-in. vitrified pipe sewer, \$1.80 per lin. ft.; 100 770 lin. ft. 30-in. brick sewer, \$3.70 per lin. ft.; 100 cu. yds. rock excav., \$3 per cu. yd.; 50 cu. yds. concrete, \$5 per cu. yd.; 50 cu. yds. brick masonry, \$7 per cu. yd.; 10 m. ft. flooring, \$20 per m. ft., and 6 receiving basins, \$35 ea. Other bids received on this work were as follows: Chas. Ormsby, 98 per cent.; J. H. R. Shannon Co., 600 Communipaw Ave., 97 per cent.; Bernard Gannon, 41 Graham St., 97 per cent.; Philip O'Reilly & Co., 148 Ocean Ave., 95 per cent., and Chas. O'Neill, 88 per cent.

Orange, N. J.—The Common Council has under consideration the proposition of Chas. W. Doughty, 28 School St., Boston, Mass., to install a plant and process for treating sewage.

Cape May, N. J.—The City Council has passed an ordinance authorizing an appropriation of \$72,000 to extend the sewerage system to the new Cape May land, bonds to be issued to obtain the money.

Haddonfield, N. J.—Specifications are on file in the office of The Engineering Record for constructing a sewage and pumping plant system in Haddonfield, bids for which are to be opened on Sept. 27, as advertised in The Engineering Record.

Paterson, N. J.—Chas. N. Sterrett, Chmn. Citizens' Com. on Sewage Disposal, it is stated, has appointed a sub-committee of which Dr. Robt. M. Curtis is a member, to investigate ways and means for the purification of the Passaic River.

New York, N. Y.—Bids will be received until Sept. 19 by Louis F. Haffen, Pres. Boro. Bronx, for constructing sewers and appurtenances in portions of numerous streets. Engineer's estimate: 6,916 lin. ft. 18, 15 and 12-in. pipe sewer; 145 lin. ft. 12-in. drain pipe, furnished and laid; 1,560 2 x 9 ft., 300 26 x 36 ft., 190 3 x 6 ft., 350 3 x 9 ft., and 16 2 x 6 ft. brick sewers; 99 manholes; 95,000 ft. B. M. timber for foundations, furnished and laid, and sheeting furnished and left in place; 1,325 cu. yds. rock, to be excavated and removed, etc., all in Boro. Bronx.

Norwood, O.—Bids will be received until Sept. 25 by W. E. Wichgar, City Treas., Norwood, at the office of J. A. Stewart, Rm. 813, Traction Bldg., Cincinnati, for \$25,000 bonds for constructing sewers.

Youngstown, O.—It is stated that bids will be received until Sept. 12 by the Bd. Pub. Service (G. T. Prosser, Clk.) for constructing a sewer in Myrtle Ave. F. M. Lillie, City Engr.

Lorain, O.—Bids will be received until Sept. 13 by the Bd. Pub. Service (H. G. Baxter, Pres.) for furnishing materials and constructing sewers in portions of several streets.

Columbus, O.—It is stated that bids will be received until Sept. 15 by the Bd. Pub. Service (Julian Griggs, Ch. Engr.) for constructing a sanitary sewer in a portion of Richardson Ave.

Dayton, O.—It is stated that bids will be received by the Bd. Pub. Service (Wm. F. Miller, Clk.) for constructing storm water sewers in a number of streets: Approximate quantities: 3,805 ft. 24, 20, 15 and 12-in. pipe sewer; 8 manholes and 33 catch basins. F. M. Turner, City Engr.

Springfield, O.—The Sewer Com. of Council has authorized the City Solicitor to take steps to have the citizens vote on the \$225,000 bond issue at the coming fall election. This is the first step toward the installation of a sanitary sewer system and disposal plant, costing \$981,000. W. H. Sieverling, City Engr.

Cincinnati, O.—The City Council has approved the plat for the sewer in Harrison Ave.

It is stated that bids will be received until Sept. 13 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for constructing sewers and drains on Herschel Ave. J. E. Breen, City Engr.

Piqua, O.—A. G. Meyers, of Dayton, is stated to have secured the contract for constructing a sanitary sewer in Guernsey and Weber Sts., for \$4,930.

**Cleveland, O.*—The following are the bids received Aug. 29 by the Bd. Pub. Service for constructing sewers in Bway, Harvard and Seager Sts.: The W. J. Townsend Co., 103 Miles Ave., \$13,828 (awarded contract); Jas. Duff & Co., \$16,000; C. Burkhardt, \$17,952, and Lehman, \$22,715. Following are the unit prices of the successful bidder on some of the materials to be used: 7,070 cu. yds. excav., 65 cts.; 260 cu. yds. Port. cement concrete, \$5.30; 600 cu. yds. brick masonry, \$7.80; 660 lin. ft. 24-in. d. s. vitrified pipe, exclusive of excav., \$1.24; 600 lin. ft. 18-in. d. s. vitrified pipe, exclusive of excav., 70 cts.; 5,600 lbs. iron in manholes, etc., 3 cts.; 160 lin. ft. 12-in. sewer and catch basin pipe, laid, 36 cts.; 25 house and sewer connections, ea., \$4; 8 catch basin connections, ea., \$5; 2 catch basins, complete, ea., \$38; 3 12-in. junctions, ea., 85 cts.; 40 6-in. junctions, ea., 30 cts.; 100,000 planks and timbers, per 1,000 B. M., \$12; 10,000 wooden invert, per 1,000 B. M., \$18; 350 sq. ft. Medina D. B. stone, relaid, 12 cts. per sq. ft., and 50 sq. ft. Medina D. B. stone, furnished and laid, 28 cts. per sq. ft.

Bids will be received until Sept. 15 by the Bd. Pub. Service (A. R. Callow, Secy.) for grading and filling necessary for maintaining and protecting earth embankment over Walworth Run sewer in a portion of Walworth St.

Marietta, O.—A. F. Cole, City Engr., writes that G. A. Stanfield, of Marietta, on Aug. 30, bid for constructing 15, 12, 10, 8 and 4-in. sewers, including manholes and flush tanks, \$5,052.

Altoona, Pa.—Bids will be received until Sept. 13 by the Bd. Pub. Wks. (And. Kipple, Chmn.) for constructing 2,787 ft. 8-in. and 157 ft. 10-in. vitr. clay pipe sewers, with 141 6-in. and 4 8-in. Y's.

**Scranton, Pa.*—The following are reported to be the bids received Sept. 1 for constructing Section F of the 5th Sewer Dist.: J. W. Manley, \$2,284 per lin. ft.; house connection, 60 cents and \$1.60; basin, \$50; manholes, \$50. V. A. O'Hara, \$2.26 per lin. ft.; house connection, 60 cts. and \$1.60; basin, \$60; manholes, \$38 (awarded contract). There is about 7,100 lin. ft. of sewer to be laid. The cost is estimated at \$16,252.

Norristown, Pa.—Bids will be received until Oct. 10 by the Sewer Com. (Wm. J. Wells, Chmn.) for constructing sanitary sewers and laterals, as advertised in The Engineering Record.

North York, Pa.—Ide & Heiges, of York, it is stated, have been engaged to make surveys and prepare plans and specifications for the proposed sewer system for North York. The sewers are to be of terra cotta.

Titusville, Pa.—Plans for brick and pipe sewers are under consideration, but no steps will probably be taken in the matter before spring. H. A. Holstein, City Engr.

Rock Hill, S. C.—A movement is on foot in this city to install a system of sewerage and a sewage disposal plant (septic tank) to cost about \$50,000. A mass meeting of the citizens is to be held in a few days to consider the matter.

Knoxville, Tenn.—The Bd. of Mayor and Aldermen Sept. 1 appropriated \$15,273 for building sewers in several streets.

Wenatchee, Wash.—W. R. Prowell, City Engr., is the

engineer in charge of sewers to be constructed in Dists. 1 and 2, for which bids will be received Sept. 26. Probable cost \$6,500. A. A. Bousquet, City Clk.

**Oconto, Wis.*—Smith Bros., Oconto, received the contract Aug. 16 for constructing sewers at \$2,505. W. A. Holt, Mayor.

Shoshone Agency, Wyo.—See "Water."

**Clinton, Ia.*—Chas. P. Chase, City Engr., writes that the following are the bids opened on Aug. 24, by the City Council for constructing sewers in Dist. 4, about 4 miles: (a) People Constr. Co., Davenport; (b) Harding & Nelson, Racine, Wis. (awarded contract); (c) J. C. Goodwin Co., Clinton; (d) W. N. Dearborn, Stone City; (e) Thos. Carey, Division "B," Clinton:

	a	b	c	d	e
Steele and concrete sewer—					
1,700 ft., 6 ft. 3 in. x 10 ft. (earth section).....	\$11.50	\$10.35	\$15.00	\$11.50	....
380 ft., 6 ft. 3 in. x 10 ft. (rock section).....	8.50	7.05	11.00	7.90	....
1,360 ft., 6 ft. 3 in. x 9 ft. (rock section).....	7.35	6.80	9.60	6.99	....
372 ft., 5 ft. 9 in. x 8 ft. (rock section).....	7.50	6.75	8.55	6.95	....
500 ft., 5 ft. 9 in. x 8 ft. (earth section).....	7.85	7.05	9.85	7.99	....
1,040 ft., 66-in. circular.....	4.50	4.50	9.05	4.06	....
Plain concrete sewer—					
400 ft., 5 ft. 3 in. x 7 ft. (rock section).....	4.95	4.45	7.86	4.50	....
400 ft., 5 ft. 3 in. x 7 ft. (earth section).....	5.60	5.05	8.66	6.00	....
600 ft., 5 ft. 3 in. x 6 ft. (earth section).....	5.35	4.80	9.50	5.00	....
200 ft., 5 ft. 3 in. x 6 ft. (rock section).....	4.45	4.00	7.50	5.00	....
510 ft., 4 ft. 6 in. x 5 ft. 6 in. (rock section).....	4.10	3.70	5.00	4.00	....
300 ft., 4 ft. 6 in. x 5 ft. 6 in. (earth section).....	4.70	4.20	5.55	4.50	....
810 ft., 4 ft. 3 in. x 5 ft. (rock section).....	3.52	3.15	4.00	3.25	....
376 ft. 60-in. circular.....	3.65	3.25	3.20	3.50	....
376 ft., 57-in. circular.....	3.25	2.95	3.00	3.00	....
376 ft., 51-in. circular.....	2.80	2.50	3.00	2.75	....
786 ft., 42-in. circular.....	2.60	2.35	3.60	2.50	2.25
1,050 ft., 40-in. (rock section).....	2.80	2.50	2.80	2.49	....
340 ft., 40-in. (earth section).....	2.80	2.50	3.20	2.49	....
Brick sewer—					
800 ft., 48-in. circular (2 ring).....	4.60	4.15	4.00	4.14	....
480 ft., 40-in. (2 ring).....	3.85	3.45	3.50	3.41	....
400 ft., 42-in. (1 ring).....	3.30	3.00	3.00	3.20	2.20
1,200 ft., 30-in. x 45 in. (1 ring).....	3.15	2.85	2.50	2.84	2.17½
800 ft., 26 in. x 39 in. (1 ring).....	3.00	2.70	2.00	2.65	2.12½
400 ft., 28 in. x 42 in. (1 ring).....	2.75	2.45	2.10	2.40	2.15
410 ft., 22 in. x 33 in. (1 ring).....	2.50	2.25	1.90	2.31	2.10
Vitrified pipe—					
1,417 ft., 36 in.	4.30	3.85	4.00	3.80	3.25
2,077 ft., 30 in.	3.60	3.65	3.60	3.80	2.75
1,321 ft., 24 in.	2.10	1.90	2.60	2.00	2.25
820 ft., 20 in.	2.10	1.90	2.10	2.00	2.15
1,871 ft., 18 in.	1.40	1.25	1.44	1.50	1.85
200 ft., 12 in.	1.00	.90	.60	1.00	1.15
153 catch basins.....	32.00	32.00	25.00	30.00	26.00
378 10-in. connecting pipe for catch basins.....	8.50	8.50	8.50	7.75	5.50
48 manholes.....	38.00	34.00	35.00	37.00	60.00
Bulkhead protection.....	1,350.00	1,200.00	700.00	1,375.00	....
2,500 sq. yds. rip rap.....	1.10	1.00	.50	.98	....
Concrete under railways (per cu. yd.).....	6.00	8.00	6.00	6.75	....
18,600 cu. yds. rock excav.....	2.20	2.25	2.00	2.35	3.75
23,872 ft., 8-in. vitr. drain tile.....	1.20	.27	.25	.35	.35
Timber left in ditch (per M.).....	21.00	21.00	21.00	21.00	21.00
Totals.....	\$164,401	\$156,732	\$177,860	\$172,821	\$50,216

Ames, Ia.—The following are the bids received Aug. 28 for constructing about 3½ miles of sewers and drains: (a) Marston, Engr. Ames; (b) R. C. De LaHunt, Cedar Rapids; (c) Des Moines Bridge & Iron Co., Des Moines, \$23,985; (d) J. W. Turner, Des Moines, \$24,238; (e) R. E. Jackson, Cedar Rapids, \$26,876; (f) W. A. Edgar, Cedar Rapids, \$27,972; (g) King Lambert Constr. Co., \$25,862; (h) Lytle Constr. Co., Sioux City, Ia., \$22,362; (i) Jas. Harrabin Co., \$29,707; (j) Daily & Brown, Jacksonville, Ill.; (k) W. F. Cook, Des Moines, \$24,759.

	a	b	c	d	e	f	g	h	i	j
2,600 ft. 10-in. sewer....	\$1.45	\$1.44	\$1.40	\$1.49	\$1.49	\$1.46	\$1.15	\$1.575	\$1.355	\$1.50
14,980 ft. 8-in. sewer....	1.29	1.02	1.18	1.18	1.30	1.18	1.05	1.485	1.192	1.10
17,670 ft. 6-in. sub-drains.....	.15	.185	.18	.20	.16	.17	.12	.05	..	.15
21 manholes.....	43.00	47.00	37.00	38.00	42.00	35.00	35.00	40.00	35.00	35.00
21 lampholes.....	8.00	14.00	15.00	11.00	10.00	12.00	4.00	50.00	21.00	15.00
5 M. H. and F. T.'s.....	90.00	123.00	110.00	100.00	99.00	100.00	90.00	100.00	75.00	105.00
2 flush tanks.....	70.00	100.00	80.00	75.00	80.00	75.00	75.00	35.00	60.00	60.00

Long Island City, L. I., N. Y.—The following are the bids opened on Aug. 31 by Jos. Cassidy, Pres. Queens Boro., for constructing sewers in 2d Ave., Boro of Queens: (a) Thos. Tuohy Co., 126 Washington St., Flushing, L. I.; (b) Peace Bros., 20 Main St., Flushing, L. I.; (c) Queens Borough Constr. Co., Ozone Park, L. I.; (d) John Hone, L. I. City:

	a	b	c	d
Vitr. salt-glazed or cement concrete sewer pipe—	\$3.35	\$2.25	\$3.50	\$2.45
2,605 lin. ft. 12-in.	3.80	2.75	3.95	2.60
690 lin. ft. 15-in.	4.10	3.00	4.20	3.00
1,455 lin. ft. 18-in.	1.50	1.50	1.00	1.00
250 lin. ft. 12-in.	1.00	.70	1.05	.75
9,100 lin. ft. 6-in.	65.00	60.00	55.00	60.00
31 manholes.....	195.00	175.00	180.00	175.00
7 receiving basins.....	5.00	5.00	4.00	5.00
150 cu. yds. rock, excav. and removed.....	12.00	9.00	9.00	6.00
75 cu. yds. concrete.....	40.00	35.00	38.00	35.00
15 M. ft. timber for foundation.....	30.00	.01	27.00	.01
125 M. ft. timber for bracing.....				
Totals.....	\$36,169	\$23,905	\$35,944	\$24,427

Long Island City, L. I., N. Y.—The following are the bids opened on Aug. 31 by Jos. Cassidy, Pres. Queens Boro., for constructing sewer and appurtenances in Oak St. from Flushing Creek to 17th St., and in 17th St. from Oak St. to Cypress Ave., and in Cypress Ave., from 17th St. to 16th St. and in Queens Ave. from 17th St. to 20th St., and the construction of 14 catchbasins; also the erection of a sewerage disposal plant in connection therewith, all of the same being situated in Ingleside, Third Ward, Boro. of Queens: (a) Peace Bros., 20 Main St., Flushing, L. I.; (b) Queens Borough Constr. Co., Ozone Park, L. I., and (c) Uvalde Asphalt Paving Co., 1 Bway., N. Y. City.

	a	b	c
725 lin. ft. 9-ft. sewer, including portal at outlet.....	\$60.60	\$40.00	\$31.90
1,580 lin. ft. 8-ft. 9-in. sewer.....	50.00	36.00	30.45
1,007 lin. ft. 8-ft. sewer.....	45.00	35.00	27.17
774 lin. ft. 6-ft. 6-in. sewer.....	34.00	24.00	22.45
810 lin. ft. 6-ft. sewer.....	31.50	21.00	20.68
1,830 lin. ft. 5-ft. 3-in. sewer.....	25.00	15.00	16.98
245 lin. ft. 2-ft. 6-in. sewer.....	13.00	12.00	5.00
350 lin. ft. 12-in. culvert pipe.....	1.00	.75	.50
14 receiving basins.....	1.50	1.50	.50
43 manholes.....	50.00	40.00	20.00
14 domes.....	75.00	50.00	46.00
7,000 lin. ft. 12-in. pipe sub-drain.....	200.00	150.00	143.00
800 M. ft. timber for foundation.....	5.00	5.00	.50
650 M. ft. timber for bracing.....	12.00	8.00	5.00
20,000 lin. ft. piles.....	30.00	30.00	24.00
1,000 cu. yds. rock, excavated and removed.....	25.00	.01	24.00
100 cu. yds. concrete.....	.05	.24	.30
Erection of a sewerage disposal plant.....	163,000.00	116,000.00	60,000.00
Totals.....	\$493,716.00	\$348,292.00	\$274,759.00

*Items marked thus give the names of parties awarded contracts.

Belleville, Ont.—It is reported that an election will probably soon be held to vote on the question of constructing a sewerage system at a probable cost of \$100,000.

BRIDGES.

Notes Arranged Alphabetically by States.

Pine, Idaho.—It is reported that bids will be received until Sept. 16 by the Bd. Co. Comrs. at Mountain Home, for constructing a bridge over the south fork of the Boise River at Pine. Dan W. Shelter, Co. Clk.

Chicago, Ill.—See "Miscellaneous."

Peoria, Ill.—It is reported that plans and specifications for a new bridge will be received Oct. 2; C. M. Dolan, City Engr.

Indianapolis, Ind.—Bids will be received until Sept. 18 by the Bd. Co. Comrs. (John McGregor, Chmn.) for constructing several culverts throughout the county; also 4 bridges.

Bids will be received until Sept. 11 by the Bd. Pub. Wks. (M. A. Downing, Pres.) for constructing a bridge at Senate Ave., over Fall Creek.

***Portland, Me.**—The contract for constructing Vaughan's Bridge over Fore River (bids opened July 8) is stated to have been awarded to New Jersey Bridge Co., of New York, N. Y., at \$339,555.

Boston, Mass.—Bids will be received until Sept. 14 by Wm. Jackson, City Engr., for the pile and trestle work of Brookline St. Bridge.

***Mt. Clemens, Mich.**—The Common Council is stated to have awarded the contract for constructing the Gratiot Ave. Bridge over Clinton River to the Huron Bridge & Iron Wks., at Port Huron, for \$7,480.

Minnesota City, Minn.—The village is in the market for a 65-ft. span. For further information address G. P. Coleman, Consulting Engr., Winona, Minn.

Winona, Minn.—Bids will be received until Sept. 18 for building stone or concrete abutments and a 30-ft. span. G. P. Coleman, City Engr.

Sandstone, Minn.—Bids will be received until Sept. 26 by the Bd. Superv., at the office of Adolph S. Larson, Town Clk., for \$6,000 bonds for constructing a bridge in said town.

Manhato, Minn.—Bids will be received by the Bd. Co. Comrs. until Sept. 26, for constructing a steel bridge with stone piers over Hughes Creek, in Cambria Township; Ed. Weaver, Co. Aud.

Newark, N. J.—Bids will be received until Sept. 11 by the Com. on Roads and Assessments, Bd. Chosen Freeholders (Wallace Ougheltree, Chmn.) for recovering a bridge on Parsonage Hill Road with iron beams and brick arches.

Utica, N. Y.—It is reported that many highway and railroad bridges throughout Chenango and Otsego Counties have been destroyed by the floods.

***Lockland, O.**—The County Comrs. are stated to have awarded the contract for constructing a swing bridge over Miami and Erie Canal in Benson St., to the Brackett Bridge Co., 518 Walnut St., Cincinnati, for \$20,800.

Springfield, O.—It is stated that bids will be received until Sept. 29 by the Bd. Park Comrs. (Thos. D. Wallace, Pres.) for constructing 2 concrete-steel arch bridges over Indiana Run in Snyder Park.

Cleveland, O.—Bids will be received until Sept. 23 by the Bd. Co. Comrs. (Julius C. Dorn, Clk.) for constructing a masonry culvert in Euclid Township, and earth and rip-rap fill in Mayfield Township.

***Shimersville, Pa.**—The Eastern Foundry & Machine Co., Easton, is stated to have received the contract for erecting an iron bridge over Sancon Creek for \$6,300.

Charleston, S. C.—See "Railroads."

Memphis, Tenn.—Plans are stated to have been completed for the viaduct to be constructed over the Illinois Central Ry. tracks at McLemore Ave.; probable cost, \$60,000.

***Rio Grande City, Tex.**—The County Comrs. are stated to have awarded the contract for constructing a steel bridge over Olmas Arroyo, near here, to the Texas Bridge Co., for \$6,000.

Milwaukee, Wis.—The Finance Com. of the Common Council is stated to have endorsed the resolution to submit to a vote of the people an ordinance providing for the issuance of \$200,000 bonds for the building of a new bridge on E. Water St.

Walkerville, Ont.—W. F. Brown, of Walkerville, Ont., and Toledo, O., U. S. A., has been instructed to prepare plans for three 40 ft. reinforced concrete spans (arches), with 60 ft. roadway and 10 ft. sidewalks. Bids will soon be asked for the construction.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Guilford, Conn.—Bids will be received until Sept. 14 by the Bd. Selectmen (P. L. Parker, Chmn.) for constructing either a gravel or macadam section of road in this town.

Wilmington, Del.—Bids will be received until Sept. 19 by Francis A. Price, State Highway Comr., 1009½ Market St., for building a macadam road known as "Foulp" road, in all a distance of about 2 miles.

***Theobald Harsch, Narberth, Pa.** has received the contract for macadamizing 12,770 ft. on "State Road" (bids received Aug. 29) at \$18,437, and Stewart & Donoh, Wilmington, the contract to macadamize 8,800 ft. of "new" road at \$13,224 (bids received Sept. 5). Francis A. Price, New Castle County Highway Comr.

***Sullivan, Ill.**—The Local Bd. of Improv. is stated to have awarded the contract for paving portions of Main and Jackson Sts. to C. D. Fry & Co., of Greencastle, Ind., for \$13,931.

Chicago, Ill.—See "Miscellaneous."

Chicago, Ill.—Bids will be received until Sept. 13 by the Bd. Local Improvements (And. M. Lynch, Pres.) for grading, curbing and paving with asphalt and slag, portions of 5 streets.

The following are reported to be the lowest bids received Aug. 30 for paving portions of streets as follows: Fargo Ave., Smith, Brown & Co., \$8,255; 64th St., Illinois Improvement & Ballast Co., \$7,441; Union Ave., Union Paving Co., \$3,791; Halsted St., Illinois Improvement & Ballast Co., \$31,500 and Ada St., John A. McGary & Co., \$79,154.

Freeport, Ill.—Bids will be received until Sept. 20 for paving an alley with brick on a concrete foundation, cost \$5,000, and Foley St., with brick to cost \$5,000, as advertised in The Engineering Record.

Joliet, Ill.—It is proposed to pave with sheet asphalt on Hickory and Scott Sts. and 4th and 1st Aves., work to be done next spring.

Bloomington, Ill.—The City Council has passed an ordinance to pave with asphalt on N. Main St. E. Folson, City Engr.

***Rock Island, Ill.**—The contract for paving with asphalt on 21st St. is stated to have been awarded to the McCarthy Improvement Co., of Davenport, Ia., at \$1.76½ per sq. yd.; probable cost of the improvement \$7,800.

Indianapolis, Ind.—Bids will be received until Sept. 15 by the Bd. Pub. Wks. (M. A. Downing, Pres.) for grading, graveling and rolling the roadway, grading and paving the sidewalks with cement on a portion of Temple Ave.; also grading and paving with cement the sidewalks on portions of Central Ave. and Union St.

Bids will be received until Sept. 11 by the Bd. Pub. Wks. (M. A. Downing, Pres.) for grading, graveling and rolling the roadway on a portion of Davis St.

Bedford, Ind.—Fred. Huffman, of Hartford City, is stated to have received the contract for paving portions of J., 15th and 16th Sts. with vitrified brick or block, for \$24,594. Bids opened Aug. 22.

***Delphi, Ind.**—The Western Constr. Co., of Lafayette, Ind., secured the contract on Aug. 21 for paving 13,720 sq. yds. with bitulithic at \$1.79 per sq. yd., 3,554 ft. combined curb and gutter at 60 cts. per lin. ft. and 3,567 cu. yds. excav. at 28 cts. per cu. yd. The Hoosier Construction Co. bid \$1.84 per sq. yd. for the paving and 62 cts. per lin. ft. for the curb and gutter.

Topeka, Kan.—The City Engr. has submitted estimates, plans and specifications for the repaving of Kansas Ave. from Gordon St. to 10th Ave., a distance of about 1½ miles. It is proposed to resurface with either sheet asphalt, natural rock asphalt or bituminous macadam.

There is some talk of the City putting in a municipal asphalt plant.

Hutchinson, Kan.—T. G. Elbury, City Engr., writes that bids are about to be asked for paving about 9 blocks with bitulithic; probable cost \$75,000.

***Everett, Mass.**—The contract to pave Main St. (bids opened Sept. 5) has been awarded to Warren Bros., of Boston. Geo. S. Marshall, Chmn. Bd. Pub. Wks.

***Boston, Mass.**—The contract to grade and construct macadam roads at Ft. Warren (bids received Aug. 10) has been awarded to Jos. J. Callahan, Atlantic, Mass., at \$4,400.

***Northstable, Mass.**—Wm. Sears and Joyce Taylors, of Hyannis, Mass., have secured the contract to construct 2 sections of macadam roads, in all about 3½ miles. Bids received Sept. 1. Edgar H. Lovell, Selectman.

Towson, Md.—Bids will be received until Sept. 14 by Co. Highway Comrs., for grading and macadamizing about 1 mile of the public highway.

Upper Marlboro, Md.—Thos. H. Lyons is stated to have submitted the only bid for improving the Livingston Road and Baltimore and Washington Turnpike, the bid being \$18,000.

***Baltimore, Md.**—F. E. Snyder & Co. are stated to have received the contract for regrading and macadamizing a portion of Philadelphia Road and Mt. Carmel Road for \$6,300 and \$7,752 respectively.

Jackson, Mich.—About 1,200 yds. of paving are to be laid. Material not yet decided upon. A. B. Stevens, City Engr.

Clover (P. O. Hinckley), Minn.—Bids will be received until Sept. 25 by the Bd. Superv. (C. O. Morgan, Chmn.) of the town of Clover at the residence of C. B. Brown in said town, for \$8,000 road construction bonds.

***Stillwater, Minn.**—Carlson & Sandquist, of Stillwater, are stated to have received the contract for repaving portions of Main and Chestnut Sts., with brick at \$2 per sq. yd.

***St. Paul, Minn.**—The Bd. Pub. Wks. is stated to have awarded the contract for macadamizing a portion of Cherokee Ave. to Thos. Keogh, at \$7,700.

Shelbina, Mo.—All bids received Sept. 10 for furnishing material and constructing about 75,000 sq. ft. cement and granitoid walks have been rejected and the Mississippi Valley & Gulf Ry. Co. (Elmer L. Gochanow, Secy-Treas.) will do the work themselves.

***Lacoma, N. H.**—The contract for paving Elm St. with tar concrete on a cement concrete base, has been let to L. D. Clark, Lakeport.

New York, N. Y.—Bids will be received until Sept. 19 by Louis F. Haffen, Pres. Boro. Bronx, for regulating, grading, curbing, flagging, paving and repaving portions of

9 streets. Engineer's estimate: 118,000 sq. yds. asphalt block; 3,960 sq. yds. asphalt; 10,960 lin. ft. new curb, furnished and set; 31,955 lin. ft. old curb, furnished and set in concrete; 53,830 sq. ft. new flagging, furnished and laid; 6,100 new bridgestone, furnished and laid; 3,950 sq. yds. Medina sandstone block; 2,370 sq. yds. granite block; 25,155 cu. yds. concrete, including mortar bed; 171,200 cu. yds. filling; 11,600 cu. yds. earth and 600 cu. yds. rock excav., etc.; also regulating, grading, curbing and constructing steps on portions of E. 166th St. and W. 177th St. Engineer's estimate: 680 cu. ft. new granite steps, furnished and set; 530 lin. ft. railing in place; 590 cu. ft. new granite coping and newels furnished and set; 1,475 sq. ft. new flag; 2,100 cu. yds. excav. 400 lin. ft. new curb, etc.

Long Island City, L. I., N. Y.—The lowest bid opened on Aug. 31 by Jos. Cassidy, Pres. Boro. of Queens, for laying sidewalks on 9th Ave., from Grand to Flushing Ave., 1st Ward, was submitted by the Long Island Constr. & Supply Co., of Long Island City, as follows: 15,000 cu. yds. earth excav., 15 cts.; 3,900 lin. ft. concrete curb, \$1.38; 20,000 sq. ft. cement sidewalks, 18 cts., and 250 sq. ft. new bluestone bridging, 60 cts.; total, \$11,382; the other bids received were from Theron H. Burden, L. I. City, \$12,440; Thos. A. Brown, L. I. City, \$12,549.

Peace Bros., of Flushing, on Aug. 31, bid for regulating, grading, curbing and laying sidewalks on 5th Ave. as follows: 4,500 cu. yds. earth excav., 50 cts.; 4,100 lin. ft. concrete curb, 85 cts.; 19,600 sq. ft. cement sidewalk, 15 cts.; 1,800 sq. ft. bluestone bridging, 67 cts.; total, \$9,881.

Long Island City, L. I., N. Y.—The following are the bids opened on Aug. 31 by Jos. Cassidy, Pres. Queens Boro., for regulating, curbing and laying sidewalks on Van Valst Ave., from Ridge St. to Hoyt Ave.; (a) Long Island Constr. & Supply Co., L. I. City, \$22,980, and (b) Peace Bros., 20 Main St., Flushing, L. I., N. Y., \$27,000:

	a	b
14,000 cu. yds. earth excav.	\$0.26	\$0.45
2,000 cu. yds. earth fill (furnished)	.70	.50
9,000 lin. ft. concrete curb	1.08	.90
39,000 sq. ft. cement sidewalks	.18	.16
8,000 sq. ft. new bluestone bridging	.15	.67

Johnstown, N. Y.—Bids will be received Oct. 2 by the City Clk. for paving with sheet asphalt 1,800 sq. yds. on S. Perry St. and 10,000 sq. yds. on Market St. Probable total cost, \$32,100. J. F. Campbell, City Engr.

Rochester, N. Y.—The following are reported to be the bids received for paving with asphalt on Franklin St.; Rock Asphalt Paving Co., \$15,750; Rochester Vulcanite Paving Co., \$15,860, and Whitmore, Rauber & Vicinus, \$15,850.

***Oneida, N. Y.**—The Bd. Pub. Wks., it is reported, has awarded the contract to pave with metal block and curb with Medina sandstone on Sconodoo, William, Madison, West and Chestnut Sts., to T. D. Allen & Co., at a total of about \$40,000.

Chillicothe, O.—It is stated that bids will be received by the Bd. Pub. Service, until Sept. 12, for about 4,600 sq. yds. brick paving and 2,550 ft. curbing. H. M. Redd, City Engr.

Marysville, O.—The City Council is stated to have rejected all bids received for paving W. 4th St.

Cincinnati, O.—Bids will be received until Sept. 27 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for improving a portion of Daytona Ave., by grading, curbing and macadamizing.

New bids will not be asked on the paving of Warsaw Ave. from State to Grand Aves. with bitulithic for some time to come.

Cleveland Heights, O.—Bids will be received until Sept. 26 by Wm. G. Phare, Village Clk., 402 Am. Inst. Bldg., Cleveland, for improving a portion of Fairmont Boulc., by grading, draining and paving with macadam. Wm. H. Evers Co., Engrs., 237 The Arcade Cleveland.

Bowling Green, O.—Bids will be received until Sept. 18 by the Bd. Co. Comrs., for \$50,000 highway improvement bonds; B. C. Harding, Co. Aud.

Columbus, O.—Bids will be received until Sept. 18 by the Bd. Pub. Service (Chas. H. Frank, Secy.) for constructing and repairing sidewalks on portions of 6 streets and upon portions of 30 other streets where the estimate of cost is less than \$500.

Springfield, O.—Bids will be received until Sept. 11 for paving with brick or brick block on alleys. Probable total cost, \$10,000. W. H. Sieverling, City Engr.

***Newton, Pa.**—The contract for macadamizing the Street Road from Trevoise to Southampton, as stated to have been awarded to the Schlimme Constr. Co., of Glenside, for \$21,203.

***Spokane, Wash.**—The contract for grading, curbing, parking and constructing sidewalks on a portion of Shannon Ave. is stated to have been awarded to Peter Costello, for \$9,000.

Everett, Wash.—The City Council is stated to have decided to pave with creosote blocks a portion of Hewitt Ave., at an estimated cost of \$55,000.

***Madison, Wis.**—The contract for paving with asphalt about 20,000 sq. yds. about capital square, is stated to have been awarded to the Barber Asphalt Co., of Chicago, Ill., for about \$44,410 (bids opened Aug. 30).

Toronto, Ont.—The paving of the portions of the following streets is reported under consideration: Seaton St., asphalt, \$19,933; McMsater Ave., bitulithic, \$3,867; Duferin St., bitulithic, \$12,848; Beatrice St., asphalt, \$3,874; Alexander St., asphalt, \$7,110; Hackney St., asphalt, \$6,986.

POWER PLANTS. GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Opelika, Ala.—Improvements are to be made by the Opelika Electric Light Co., at a cost of about \$220,000. No engineer has been selected as yet and no date set for the receiving of bids. Rush Taylor, 1st vice-pres. Opelika Ry., Light & Power Co., Opelika.

Troy, Ala.—H. McKee, Pres. Troy Gas Co., writes that it is proposed to expend about \$50,000, and bids for construction will be received about Oct. 1.

*Items marked thus give the names of parties awarded contracts.

Albertville, Ala.—A number of the business men of Albertville have organized a company to be known as the North Alabama Ry., Light & Power Co., with a capital of \$100,000. The purpose of the company is to connect all Sand mountain towns with an electric railway, provide water works for the larger towns and to light the towns with electricity. J. G. Elrod, Pres.; N. A. Elrod, vice-pres. and bus. mgr., and W. M. Coleman, secy.

Gilroy, Cal.—Bids will be received until Sept. 18 by the Mayor and Common Council for \$51,000 bonds: \$11,000 for an electric light and power works and an electric lighting system; \$25,000 for constructing a sewer system, and \$10,000 for improving the present water works system. C. N. Hoover, City Clk.

Ferndale, Cal.—An ordinance has been adopted by the Bd. Superv., granting to the Ferndale Electric Light Co. (W. W. Barnes, Secy., Ferndale) a franchise to construct poles, wires and other conductors for electric purposes along the road in First Supervisorial Dist., of Humboldt County. W. H. Haw, Co. Clk.

Norwalk, Conn.—It is stated that the Mayor is to appoint a committee of three to investigate the cost of installing a municipal lighting plant.

Washington, D. C.—The contract for the furnishing of switchboards, tablet boards and cabinets for the electric light plant at the Sewage Pumping Station (bids received Aug. 28) has been secured by Malcolm Hill & Co.

Bids will be received until Sept. 19 at the Bureau Supplies and Accounts, Navy Dept., Washington, to furnish at the Navy Yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies, as follows: Electrical cable; incandescent lamps; motors; electrical supplies; circuit breakers; pipe-bending machines; galvanized sheet steel; sheet lead; hydraulic jacks, etc.; also same date at the Navy Yard, Pensacola, Fla., and the naval stations, Key West, Fla., and New Orleans, La., a quantity of naval supplies, as follows: Electrical supplies; structural steel; pipe and fittings; bar iron, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

Washington, D. C.—The Comrs. D. C. are reported to have decided to have one lighting and heating plant constructed to supply both the new municipal almshouse and the industrial home school.

Quincy, Fla.—The citizens are reported to have voted to issue \$5,000 bonds for improving the water works and electric light plant.

Chicago, Ill.—Bids will be received until Nov. 1 by the Bd. Trus., Sanitary Dist. of Chicago (S. D. Griffin, Clk.) for constructing a canal lock, movable dams and a fender wall, in connection with the water power development now being made near Lockport.

Springfield, Ill.—The City Council is reported to have authorized the Mayor to take over the properties and plant of the Springfield Electric Light & Power Co.

Ft. Wayne, Ind.—The matter of installing a gas plant has been abandoned for the present. H. W. Becker, Clk. Bd. Pub. Wks.

Valley Junction, Ia.—A. B. Rutt, Town Clk., writes that the citizens voted on Aug. 28 to grant the Capitol City Gas Light Co., of Des Moines, a franchise to lay mains and furnish this place with gas.

Waterville, Me.—The Messalouske Electric Co. (W. S. Wyman, Supt., Waterville) contemplates constructing a new water power station on Rice Rips, to cost about \$125,000.

Hyattsville, Md.—The Town Council is reported to be considering the question of constructing a municipal electric light plant.

Pittsfield, Mass.—It is reported that the Eaton-Hurlbut Co. will construct a \$15,000 power plant on S. Church St.

Warren, Mass.—The Selectmen are said to be considering the laying of gas mains in the streets.

Minneapolis, Minn.—It is stated that bids will probably soon be asked for furnishing the city 1,000 electric lights and 2,200 gasoline lamps.

***Helena, Mont.**—The Wisconsin Bridge Co., of Milwaukee, is stated to have secured the contract for the steel work to be used in the dam of the Helena Power Transmission Co.

Lovelocks, Nev.—It is reported that the installation of an electric lighting plant is contemplated.

Kearny, N. J.—It is reported that an agreement has been reached between the Public Service Corporation and the Lighting Com. on a 2-year contract for lighting the streets.

Toledo, O.—Bids will be received until Sept. 19 at the Treas. Dept., Washington, D. C. (H. A. Taylor, Acting Secy.) for installing a system of electric wiring and fixtures in the U. S. Custom House at Toledo.

Warren, Pa.—Bids will be received until Sept. 15 by S. R. Mason, Chmn. Bldg. Com., State Hospital for the Insane, for an electric lighting system, including one 100-hp. engine; one 62½-kw., 3-wire, two-voltage generator; general panel; wiring and lighting grounds, and outside buildings at the State Hospital, also building line from present dynamo room in main hospital building to Farm Colony building and wiring same; also furnishing gas engines, generator, switchboard and wiring building at Farm Colony. W. E. Parker, Electrical Engr., Ellicott Sq., Buffalo, N. Y.

Wynnewood, Pa.—Archts. Heacock & Hokanson, 931 Chestnut St., Philadelphia, write that bids will be received about Sept. 15 for the construction of a central steam heating plant at Wynnewood, for W. B. Smith; probable cost \$15,000.

Williamsport, Pa.—The Lycoming Electric Co. (Ernest H. Davis, Mgr.) is reported to have taken out a permit to erect a new power house, to cost about \$75,000.

Sinking Spring, Pa.—The Cumru Township Electric Light & Power Co. is reported formed, with Wm. F. Krick, of Sinking Spring, as President, to furnish electric light in Sinking Spring and Shillington; capital, \$5,000.

Columbia, S. C.—The gas plant of the Columbia Gas

Company is to be rebuilt, but the company is not yet ready for bids. Wm. Elliott, Jr., Gen. Mgr.

Knoxville, Tenn.—Bids are to be received, according to reports, for lighting the streets on 3, 5, 7 and 10-year periods.

Chattanooga, Tenn.—The plans for the power plant of the Chattanooga-Tennessee River Power Co., which is to construct the lock and dam power plant at Hale's bar on the Tennessee River, have been approved by the War Dept., according to reports, and are now in the hands of J. C. Guild and C. E. James, the leading stockholders of the company. It is reported that bids for the construction will probably soon be asked. John Bogart, 16 Exchange Pl., N. Y. City, N. Y., is the consulting engr.

Clinton, Tenn.—The City Council is reported to have passed on first reading the ordinance granting Wm. B. Crawford, of Oliver Springs, a franchise for water works and an electric light plant.

Luray, Va.—The Luray Gas Co. (D. G. Strickler, pres.) intends erecting a power plant at a cost of about \$30,000. N. W. Davis is the engineer in charge. Time for receiving bids has not yet been set.

Readsboro, Vt.—Faxon Bowen, of Readsboro, writes that the proposed electric power plant on Deerfield River will cost about \$1,000,000. Engineer, W. S. Morton, 36 Pearl St., Hartford, Conn.

North Yakima, Wash.—The Council is reported to have repealed the ordinance granting a franchise for a gas plant to J. J. Chambers, of Seattle, and Isaac W. Anderson, of Spokane, is reported to have petitioned for a franchise to install a gas plant.

***Milwaukee, Wis.**—The Co. Comrs., it is reported, have awarded the contract for wiring the old portion of the county hospital to Albert Smith, at \$2,837.

Mexico City, Mex.—Modesto R. Martinez, on behalf of Andres Matienzo, it is reported, has secured a concession to utilize the waters of Atoyac River in the State of Puebla for motive power purposes, the water to be used exclusively for electric or hydraulic power. A representative is to be situated in Mexico City for the transaction of all official business.

It is reported that the Mexican Power Co., a Philadelphia (Pa.) concern, with an authorized capital of \$10,000,000, operating under a New Jersey charter, has been organized and is preparing to utilize the water power of 3 rivers in the State of Mexico, near Toluca, and will furnish electric power to this city, estimated at 90,000 hp. Joel H. De Victor, 505 Chestnut St., Philadelphia, Pa., is reported interested.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Cloverdale, Cal.—F. J. Kilpatrick, of New York, N. Y., is reported to be interested in a project to construct an electric railway north from this city to Anderson Valley, Boonville and along Rancheria, Albion, Navarro, Garcia and Indian Creeks.

Ferndale, Cal.—See "Power Plants, Gas and Electricity."

San Francisco, Cal.—The Ocean Shore Ry. Co. is stated to have announced that bids will soon be opened for the construction of the line between Scott's Creek and San Francisco.

East St. Louis, Ill.—Articles of incorporation for the Illinois & Indiana Electric R. R. Co. are stated to have been filed. Capital \$2,500. Incorporators: E. J. Kurrus, J. J. Kane, B. F. Keshner and others. The company contemplates building an electric railway from East St. Louis to Centralia, Ill.

New Albany, Ind.—It is stated that the Louisville, New Albany, West Baden & French Lick Ry. Co. proposes to build an electric railway from New Albany to French Lick. Thos. Taggart, Dir. The line will be about 50 miles long, passing through the counties of Floyd, Harrison, Washington and Orange.

Indianapolis, Ind.—It is stated that the Indianapolis Suburban Belt & Terminal Ry. Co., capital \$100,000, proposes to construct an electric belt railway around the city. The route will be on the New Castle Co.'s right of way from E. 10th St. and Massachusetts Ave. to Malott Park, Flackville, Poplar Grove and Irvington. Dir.: David M. Parry, W. E. Stevenson, Chas. S. Hernly, Eli Marvin and E. H. Bundy.

It is stated that the Indianapolis & Ohio Valley Traction Co. proposes to build an electric railway from this city to Rockport, on the Ohio River.

Terre Haute, Ind.—It is stated that the Wabash & Southeastern Traction Co. proposes to build an electric railway southeast from here to Columbus, Ind.

Davis, Ind. Ter.—The City Council of Davis has granted a franchise through the streets to the Oklahoma City, Lexington & Sulphur Springs Electric Ry. Co.

Saginaw, Mich.—It is stated that work has begun on a permanent survey of the proposed line of the Saginaw Southern Electric R. R., to connect this place with Bay City. A. S. Courtwright is at the head of the surveying party.

Monett, Mo.—The City Council is reported to have passed an ordinance granting a franchise to C. W. Copeland and others for the purpose of constructing and operating an electric railway over the principal streets of Monett. The line is to be extended to Pierce City, a distance of 5 miles.

New York, N. Y.—Bids will be received until Sept. 20 by the Bd. of Rapid Transit R. R. Comrs. (Alex. E. Orr, Pres.), Room 401, 320 Bway., for making wash-borings on the line of proposed Rapid Transit Ry. routes in the Boroughs of Manhattan, Bronx, Brooklyn and Queens, including wash-borings on the lines of such routes as pass under the East and Harlem Rivers and other navigable waterways, as advertised in The Engineering Record.

White Plains, N. Y.—The Bd. of Trus. of White Plains are reported to be considering an application from the Bronx, Yonkers & White Plains R. R. Co. for a franchise to construct and operate a double-track electric railway from Yonkers to White Plains. It is understood that the company intends eventually to extend the road to Tarrytown.

Glen Cove, N. Y.—The State R. R. Comm. is stated to have granted the application of the Glen Cove R. R.

Co. for a certificate of franchise for a road of about 3½ miles from the landing at Glen Cove to the railroad depot thence by private right of way to Sea Cliff. The Long Island R. R. Co. is said to be behind the company.

Elmira, N. Y.—The Corning, Elmira & Waverly Traction Co. is reported incorporated to build an electric railway between Corning and Waverly. Capital, \$2,500,000.

East Liverpool, O.—The East Liverpool St. Ry. Co. has sold out its line to a syndicate of Buffalo and New York capitalists, who are having surveys made for about 10 miles of double track. Mr. Van Horn Ely, Thompson Hotel, is the Mgr. of the Co.

Zanesville, O.—The Zanesville & Southeastern Ry. Co. is reported organized, to build a line from Zanesville to Bellport, O. S. M. Parker, of New York, Pres.

Philadelphia, Pa.—J. E. & A. L. Penwick are stated to have received a permit for a 3-story brick and stone residence and 2-story stable to be erected at Springfield Ave. and Huron St., Chestnut Hill, for Chas. A. Porter, Jr., at a cost of \$70,000. Horace Trumbauer, Archt.

Aberdeen, S. D.—A company is reported to have been formed for the construction of a street railway system. Capital, \$10,000. S. H. Jumper, Wm. Wallace, A. C. Witte, J. L. W. Zwitlow and others are reported interested. The project comprises the construction of about 4 miles of electric railway within the city limits and a future extension of lines to suburban towns. As the situation stands at the present time, it is expected to incorporate and carry through the preliminary work this fall and winter.

Walla Walla, Wash.—The City Council is reported to have passed an amended ordinance granting a franchise to the Walla Walla Valley Traction Company for the construction of a street railway in Walla Walla. It is said to be the plan of the company to build an interurban line from this city to Milton, Ore., through the towns of College Place and Freewater. Surveys of the entire system have been completed.

Wenatchee, Wash.—The third survey of the proposed electric railway between Wenatchee and Waterville has been completed. The road will extend from Waterville through Brown Canyon to the Columbia River, and thence down the south side of the river to Wenatchee, where the river will be crossed. J. D. Atkinson, the present Attorney-General of the State, and Judge A. W. Frater, of Seattle, are reported interested.

Seattle, Wash.—A franchise is stated to have been granted to the Seattle Electric Co. for the use of 10th Ave. N., Harvard Ave. and Roanoke St. for street railway purposes. The territory outlined in the franchise covers a good sized portion of the north end of the city, and completes a loop in the system.

Saratoga, Wyo.—It is stated that the Saratoga & Denver Electric Ry. Co. will soon be incorporated, with a capital of \$500,000, to build an electric railway from Saratoga to Denver.

RAILROADS.

Notes Arranged Alphabetically by States.

***San Francisco, Cal.**—It is reported that the contract for the heavy mountain work on the Western Pacific R. R. in the Sierra Nevada Mountains has been awarded to the Utah Constr. Co., of Salt Lake City, Utah. The contract, it is stated, embraces all the heavy grading and tunnelling of the mountains, and is estimated to cost about \$8,000,000.

Pelham, Ga.—The Pelham, Bainbridge & Gulf R. R. Co. has been incorporated with a capital of \$100,000 and intends constructing a railroad from Pelham to Bainbridge. Senator J. L. Hand, of Pelham, is reported to be one of the incorporators.

***Springfield, Mo.**—The Willer Constr. Co., of Springfield, is reported to have secured the contract for grading about 32 miles of railroad from the Springfield Southwestern R. R. to connect with the White River Road.

Goldfield, Nev.—Articles of incorporation have been filed at Carson City for a railroad from Goldfield 80 miles to Bullfrog, Nev. J. W. Brock and Chas. Miller, of Philadelphia, Pa., it is reported, are interested in the movement.

Lakewood, N. Y.—It is stated that arrangements have been perfected for the third system of cut-offs on the Erie R. R., which provides for the construction of a single track line paralleling the main line between Lakewood, N. Y., at the foot of Chautauque Lake westward to Watts Flats, a distance of 15 miles. From Watts Flats, west a distance of 10 miles to Columbus, Pa., a double-track line is to be built to take the place of the existing main line. The improvements, it is stated, will cost approximately \$1,000,000.

Niagara Falls, N. Y.—It is stated that two grade crossings on the Erie R. R. (Francis Lee Stuart, Ch. Engr., New York, N. Y.) are to be eliminated. The one at Pine Ave. will be carried over the tracks at a cost of \$40,000, and the one at Niagara St. will be carried under the tracks at a cost of \$22,000. The city will pay one-fourth of the expense, the State one-fourth and the R. R. Co. one-half.

Lima, O.—Surveys are being made for the Columbus & Lake Michigan Ry., between this city and Columbus. C. T. Hobart, Ch. Engr., Lima.

Portland, Ore.—The Oregon Eastern Ry. Co. is reported incorporated here, with a capital of \$1,000,000, to build a road from Natron, Ore., to Ontario, Ore., between Huntington, Ore., and Boise, Idaho.

Shawnee, Okla. Ter.—A charter has been granted to the Tulsa, Turnerville & Texas R. R. Co., with a capital stock of \$3,500,000 and headquarters at Shawnee. Its stockholders are Jos. W. McNeal and Wm. M. Spurlock, both of Guthrie; Fred E. Turner, V. N. Sayer, of Muskogee, I. T., and others. The railroad will be built from a point on the boundary line of Kansas and Indian Territory, and run through the Cherokee Nation and the Creek Nation to the city of Shawnee in Pottawatomie County. The estimated length of the railroad is to be 175 miles and cost \$3,500,000.

Hickory, Pa.—The property franchises and unfinished construction of the Greene County Railroad and the Little Kanawha syndicate, it is stated, has been purchased by the Pittsburg & Lake Erie R. R. (J. A. Atwood, Ch. Engr., Pittsburg). A survey has been made from a point on the Hickory branch near the village of Hickory, down the valley and reaching the Pittsburg & Lake

Erie R. R. at a point near West Economy. About 12 miles of road will be built.

Allegheny, Pa.—It is reported that the Baltimore & Ohio R. R. (D. D. Carothers, Ch. Engr., Baltimore, Md.) will soon begin the construction of a new line from Allegheny, Pa., to Ellwood City.

Charleston, S. C.—It is reported that arrangements have been made by Eugene Zimmerman, of Cincinnati, O., Pres. of the Great Central route, whereby the Cincinnati, Hamilton & Dayton R. R. is to be extended to Charleston, S. C. The first step in the extension will be the construction of a bridge over the Ohio River to Ashland, Ky., to cost about \$1,500,000. From Ashland a road 125 miles in length will be built through Pike, Knott and Letcher counties in southeastern Kentucky. The construction of the road will cost about \$3,750,000. From the terminus of the new line an extension will later be built to Charleston, S. C. This line will be secured partly by the purchase of existing roads and traffic arrangements. About 200 miles of new road will have to be built.

Clinchport, Va.—Henry K. McHarg, 40 Wall St., N. Y. City, owner of the Virginia & Southwestern R. R. It is reported, is contemplating the building of a road from Clinchport to the Toms Creek mines in Wise County, Va. It is stated that surveys are being made and material for the construction being purchased.

Casper, Wyo.—The Chicago & Pacific Ry. Co., it is stated, has been incorporated with a capital of \$100,000 for the purpose of building a road from Casper, Wyo., to Ogden, Utah.

Ottawa, Ont.—Justice Killam, Chmn. of the Railway Comm., it is reported, has approved the plans submitted by the Grand Trunk Pacific Ry. Co. (H. A. Woods, Asst. Ch.) for the section of their transcontinental line from Portage la Prairie westward 275 miles.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Burlington, Vt.—The following are the three lowest bids opened on Aug. 31 by the Superv. Archt., Treas. Dept., Washington, D. C., for the low-pressure steam heating apparatus for the U. S. Post-Office at Burlington: Cleghorn Co., Boston, Mass., \$6,470; A. B. Franklin, Boston, Mass., \$6,774, and G. A. Blodgett, Burlington, \$5,340.

San Jose, Cal.—Bids will be received until Sept. 18 by A. L. Hubbard, Chmn. Bd. Co. Superv., for making alterations and additions to the Co. Hospital.

Denver, Colo.—Sterner & Williamson are stated to have received the contract for erecting the Colorado Museum of Natural History, at a cost of \$80,000.

Hartford, Conn.—Bids will be received until Sept. 15 at the office of the Comm. to take charge of lands acquired by the State as an addition to the Capitol grounds (Henry Roberts, Chmn.), State Capitol, for the removal of certain buildings on Broad St.

Wilmington, Del.—Bids will be received Sept. 12 by Harry A. Brown, Chmn. Finance Com. of the Levy Court, for \$140,000 Co. Workhouse bonds.

Ft. De Soto, Fla.—Bids will be received until Sept. 29 by Lieut. R. S. Pratt, Constr. Q. M., U. S. A., Ft. De Soto, for constructing 2 sets civilian quarters and 1 ordnance storehouse at this post; also ordnance storehouse at Ft. Dade, Fla.

Chicago, Ill.—The Co. Bd. Aug. 31 adopted a resolution to issue \$250,000 bonds for the new Court House. Bids will be received until Sept. 13 by the Dept. Pub. Wks. (J. M. Patterson, Comr.) for furnishing materials and doing all the mason, concrete, iron and cut stone work necessary to erect a 2-story and basement brick and stone fire engine house at 187 Hudson Ave.; separate bids will be received same date for doing all the sheet metal, steel ceiling and gravel roofing work; also for carpenter work, etc., all in said building.

Bids will be received until Sept. 12 by the Dept. Pub. Wks. (Jos. M. Patterson, Comr.) for furnishing, delivering and installing a steam heating apparatus at the Jackson Park Pumping Station.

Clinton, Ill.—Dr. John Warner, it is reported, has endowed a public hospital with \$25,000 and plans are being prepared for the building.

Ft. Riley, Kan.—Bids will be received until Oct. 4 by Capt. Leon S. Roudiez, Q. M., Ft. Riley, for constructing a double set of non-commissioned staff officers quarters, and for the underground rearrangement of electric lighting wire in connection with post hospital, as advertised in The Engineering Record.

Portland, Me.—The J. W. Bishop Co., Boston, Mass., has received the contract to excavate and construct the foundation for the court house (bids opened Sept. 5) at \$36,850. Geo. P. Plaisted, Clk. to Co. Comrs.

Ft. Williams, Me.—Bids will be received until Sept. 12 by Capt. A. W. Yates, Constr. Q. M., U. S. A., Portland, Me., for constructing, plumbing, heating and electric wiring the band barracks at Ft. Williams.

Worcester, Mass.—Jas. Miles & Son, it is stated, submitted the lowest bid for erecting a workshop and storehouse for the Public Bldg. Dept., at Shrewsbury and E. Worcester Sts., at \$12,100.

Newton, Mass.—It is stated that a court house will be erected in Harvey County at a cost of \$30,000.

Baltimore, Md.—H. Smith & Son, of Baltimore, have received the contract to construct the U. S. Custom House at \$352,135.

Ft. Wayne, Detroit, Mich.—Bids will be received until Oct. 4 by Capt. P. Whitworth, Q. M., U. S. A., for constructing, plumbing, heating and electric wiring a brick double set captain's quarters, double set lieutenant's quarters and 2 double barracks here, as advertised in The Engineering Record.

Grand Rapids, Mich.—Henry L. Van der Horst, of Kalamazoo, it is reported, has secured the contract to erect a hospital at the Soldiers' Home at \$66,400. Bids received Aug. 26.

Minneapolis, Minn.—The Bd. of Charities, it is stated, is contemplating the erection of an administration building for the City Hospital, at a cost of \$60,000.

Winona, Minn.—Bids will be received until Sept. 18 for building an extension to the water works building.

Jersey City, N. J.—Bids will be received until Sept. 12 by the New County Bldg. Com. (Alex. J. Clements,

Secy.) for excavating the site to be occupied by the new court house; separate bids will be received same date for removal of building now occupied by the Co. Bd. Chosen Freeholders. Hugh Roberts, Archt., 1 Exchange Pl.

Ft. Hancock, N. J.—Bids will be received until Sept. 22 by Lieut. Col. W. L. Marshall, Corps Engrs., U. S. A., New York, for furnishing, delivering and erecting a steel storehouse at Ft. Hancock, as advertised in The Engineering Record.

New York, N. Y.—Bids will be received until Sept. 15 by the Dept. Pub. Charities, for furnishing materials, plumbing and steam heating seven emergency hospital pavilions on Blackwells Island.

Bids will be received until Sept. 13 by the Bd. Health (Thos. Darlington, M. D., Pres.) for furnishing materials and erecting a gas house at the Riverside Hospital, North Brother Island, Boro. Bronx.

Bids will be received until Sept. 14 by the Park Bd. (John J. Pallas, Pres.) for erecting a public comfort building in the New York Zoological Park, in Bronx Park.

Bids will be received by Thos. W. Churchill, Deputy Acting Fire Comr., until Sept. 14, for furnishing materials for the plumbing, gas and electric systems in the new building for Engine Co. 23, Boro. Manhattan.

New York, N. Y.—Plans have been filed for a 1-story brick deer house, to be erected at Bronx Park, near Honeywell Ave., at a cost of \$40,000. Heines & La Farge, Archts., 30 E. 21st St.

*Contracts have been awarded by the Treas. Dept., at Washington, D. C., according to press reports, for the interior finish and equipment of the Custom House, in course of construction in Bowling Green. The interior work will be done by J. C. Robinson, of Chicago, for \$1,037,282. The heating plant will be installed by the New York Steam Fitting Co., 137 Elm St., for \$230,666.

Middletown, N. Y.—Bids will be received until Sept. 27 by the State Comm. in Lunacy, at Albany, for the construction, plumbing, heating, electric light wiring and fixtures for the chronic ward building at the State Homeopathic Hospital, Middletown, as advertised in The Engineering Record.

Fargo, N. D.—Bids will be received until Oct. 12 by Jas. Knox Taylor, Superv. Archt., Washington, D. C., for constructing complete, except elevator, the U. S. Post-Office and Court House extension at Fargo.

***Pierre, N. D.**—C. Lepper, of Minneapolis, Minn., it is stated, secured the contract for the foundation work of the east wing of the new capitol at \$6,086.

Memphis, Tenn.—Hale & Rogers, of Chicago, Ill., it is reported, are preparing plans for the court house, which is to be erected here at a cost of \$1,000,000. N. C. Perkins, Chmn. Court House Com.

Cape Hatteras.—See "Miscellaneous."

Waterville, Wash.—The Co. Comrs., it is reported, have decided to erect a court house at a cost of \$30,000.

***St. Boniface, Man.**—The Wm. Grace Co. has secured the contract to erect the city hall at \$33,800. Thos. Bertrand, Secy.-Treas.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Huntsville, Ala.—Plans are stated to have been prepared by W. W. Knowles for a theatre and home for Elks in Huntsville, at a cost of \$50,000. According to reports the contract will soon be let.

Los Angeles, Cal.—It is reported that a 3-story hotel is to be erected here at a cost of \$100,000, according to plans prepared by Theo. A. Eisen, 424 Stimson Bldg.

***Colorado Springs, Colo.**—St. John & Barnes are stated to have received the contract for installing a pipe line heating plant at the car barns of the Colorado Springs & Interurban Ry. Co., for about \$10,000.

Montclair, Colo.—Plans are stated to have been prepared for a hotel to be erected here by H. W. Woodruff, Kittredge & Graham, at a cost of \$90,000.

Hartford, Conn.—It is stated that bids will be received until Sept. 15 by Donn Barber, Archt., 24 E. 23d St., New York City, for erecting an 8-story brick and stone office bldg., 144x200 ft., in Hartford for the Travellers' Insurance Co.

St. Augustine, Fla.—It is stated that plans have been approved for a 3-story brick building, to be erected at Valencia and Ribera Sts., for the railroad branch Y. M. C. A.

Augusta, Ga.—W. W. Bussey & Co. is reported to have decided to erect a 40 x 150 ft. warehouse on Walker St.

***Chicago, Ill.**—The Bd. of Sanitary Dist. Trus. are stated to have awarded the contract for remodeling the 8-story warehouse at Van Buren St. to William Adams Co. for \$65,763.

***R. & S. Sollitt**, 140 Dearborn St., are stated to have received the contract for alterations to the Mercantile Bldg. of Studebaker Bros. Mfg. Co., at 378 Wabash Ave., probable cost of improvement \$50,000.

A. E. Colcord, 108 Dearborn St., is reported to have prepared plans for a 3-story, 100x165-ft. brick and stone building at Monroe Ave. and 64th St. for Louis C. Wagner, at a cost of \$150,000.

Evanston, Ill.—C. A. Wightman and J. F. Byrnes, it is stated, are interested in the project to erect a 3-story theatre on Orrington Ave., to cost \$100,000.

Terre Haute, Ind.—The Southern Indiana Ry. Co. (J. W. Thompson, Gen. Mgr.), it is reported, will build shops in Terre Haute in the spring to cost about \$1,000,000.

Duncan, Ind. Ter.—Bids will be received until Sept. 15 by John A. Weaver, Secy., Duncan Cotton Oil Co., for erecting a brick or stone oil mill at this place.

Louisville, Ky.—Richards, McCarthy & Bulford, of Columbus, O., are stated to have been selected to prepare plans for a passenger station to be erected here by the Lackawanna & Northern, the C. & O. and L. & E. Roads, at a cost of \$300,000.

Worcester, Mass.—A brick and stone bank building is to be erected at Main and Foster Sts. for the Worcester County Institution for Savings; cost, \$40,000. Archts., Winslow & Bigelow, Boston.

*Items marked thus give the names of parties awarded contracts.

***St. Paul, Minn.**—Permits have been issued for 1-story brick addition to brick building on Washington and Ontario Sts.; St. Paul Gas Light Co., owners; Newman & Hay, contractors; cost, \$30,000; for a 3-story brick building on Robert and 8th Sts.; P. J. Filben, owner; Newman & Hay, contrs.; cost, \$12,000 to \$15,000, and a 4-story brick building on E. 8th and Jackson Sts.; Butler Bros., owners and builders; cost, \$40,000.

Wabasha, Minn.—It is stated that the Chicago, Milwaukee & St. Paul Ry. Co. (O. J. Whittemore, Ch. Engr., Chicago, Ill.) will erect a new depot replacing the one recently destroyed.

St. Louis, Mo.—It is stated that bids will be received until Sept. 18 by E. Ward, Benoist Bldg., for erecting a 5-story stamping building, 44 x 104 ft., and a 1-story galvanized building, 40 x 70 ft., for the Crunden-Martin Wooden Ware Co., Main and Cedar Sts.; probable cost, \$60,000. Russell & Garden, archts., Chemical Bldg.

Omaha, Neb.—The Nebraska Seed Co. will erect a brick warehouse on Jones St. near 13th St. It will be three stories in height, 66x72 ft. The building and improvements will cost about \$25,000. Plans have been drawn and work will begin soon.

The Great Western Granite Co. have had plans prepared by J. E. Dietrich, Rm. 338, Range Bldg., for a building, 65x300 ft., to have a 30-ton hoisting crane. Cost, \$25,000. A. J. Hamilton, Gen. Mgr., Omaha.

The Krug Brewing Co. is having plans prepared by J. P. Guth, Paxton Bldg., for an addition to its bottling works to cost \$50,000.

The Omaha Casket Co. is having plans prepared by J. P. Guth, Paxton Bldg., for a factory, to replace building destroyed by hurricane, to cost \$30,000.

Fargo, N. D.—It is stated that the Great Northern R. R. Co. (A. H. Hogeland, Ch. Engr., St. Paul, Minn.) will erect a station here, at a cost of \$50,000.

***Allegheny, Pa.**—B. A. Groah is stated to have received the contract for erecting an 8-story brick warehouse at Isabella and Sandusky Sts., for Kerr & Snodgrass, at a cost of \$50,000.

***Pittsburg, Pa.**—Kerr & Fox, 2565 5th Ave., are stated to have received the contract for erecting a 6-story, 60 x 145 ft. warehouse, at Penn Ave. and Beatty St., for \$120,000.

Wilkesbarre, Pa.—John A. Redington, of Wilkesbarre, writes that it is proposed to erect a hotel here to cost about \$12,000. Architects, French & McCormack.

Willow Grove, Pa.—It is reported that the engineering department of the Philadelphia & Reading R. R. (Wm. Hunter, Ch. Engr., Philadelphia, Pa.) is preparing plans for improvements to be made at Willow Grove, which will include the erection of a new passenger station near the terminal of the Rapid Transit Co.'s lines.

Chattanooga, Tenn.—R. H. Hunt, 101 W. 8th St., is reported to be preparing plans for an addition to the Y. M. C. A. building on McCallie Ave., to cost about \$35,000.

Knoxville, Tenn.—H. O. Nelson is stated to have had plans prepared and will soon erect a brick warehouse on 2d St.; estimated cost, \$26,000.

Dallas, Tex.—It is stated that bids will be received until Sept. 25 by C. B. Gardner, Praetorian Bldg., for erecting a steel frame, fireproof, 14-story office building, including installation of plumbing, steam heating, electric wiring and elevators.

Walla Walla, Wash.—It is stated that a 3-story brick Y. M. C. A. building will be erected on Spokane St., at a cost of \$50,000.

***Seattle, Wash.**—The contract for erecting a 2-story brick building at 4th Ave. and Pike St. for Geo. Kinneer, is stated to have been awarded to Bromley & Wells, at \$30,000.

***Saunders & Lawton**, New York Bldg., are stated to have awarded contracts for erecting a building on 3d Ave., S., for the Norris Safe & Lock Co., as follows: Erection, Alex. Pearson; plumbing, G. H. Brown & Co., and heating to Rautman Plumbing Co., at an aggregate cost of \$40,000.

Milwaukee, Wis.—It is stated that the Merchants & Manufacturers Asso. have prepared plans to erect a music hall and auditorium to cost \$500,000.

Ft. Atkinson, Wis.—It is stated that the Chicago & Northwestern R. R. Co. (E. C. Carter, Ch. Engr., Chicago, Ill.) has decided to erect a depot here, to cost \$50,000.

Winnipeg, Man.—It is reported that plans are being prepared for a hotel, depot and office building, the erection of which the Canadian Pacific R. R. (Wm. M. Mackenzie, Pres.) is said to be contemplating.

NEW YORK, N. Y.

172 Cherry St., 6-story br. and stone stable; c, \$20,000; o, Geo. W. Bond; a, Robt. C. Dixon, Jr.

Delancey and Eldridge Sts., 6-story br. and stone store, office and tenemt.; c, \$65,000; o, Weinstein & J. Katz Co.; a, E. H. Meyers.

Washington and 11th Sts., 6-story br. and stone loft bldg.; c, \$145,000; o, The Builders Constr. Co.; a, C. A. French.

746 Water St., 3-story br. and stone stable and warehouse; c, \$22,704; a, Woodruff Leming.

11 E. 45th St., 9-story br. and stone hotel c, \$300,000; o, The Home Club Co.; a, Gordon, Tracy & Swartwout.

Bway, and 26th St., 8-story br. and stone hotel; c, \$40,000; o, Mrs. M. T. Johnston; a, Thain & Thain.

137th St. and 5th Ave., 6-story br. and stone store and tenemt.; c, \$40,000; o, Bookstaver & Kessler; a, Geo. F. Pelham.

Amsterdam Ave. and 178th St., 2 5-story br. and stone stores and tenemts.; total c, \$90,000; o, Cascade Realty Co.; a, Glasser & Ebert.

186th St. and Amsterdam Ave., 4 6-story br. and stone stores and tenemts.; total c, \$145,000; o, Meryash & London; a, Horenburger & Straub.

5th Ave. and 137th St., 2 6-story br. and stone tenemts. and stores; total c, \$105,000; o, Kessler & Bookstaver.

247 8th Ave., 6-story br. and stone store and tenemt.; c, \$60,000; o, Abraham Silverman; a, Geo. F. Pelham.

105 Bway., alterations to 10-story br. and stone office bldg.; c, \$40,000; o, Western Union Telegraph Co.; a, Howells & Stokes.

1454 Bway., 1-story br. and stone extension to 9-story br. and stone store and hotel; c, \$20,000; o, Ottinger & Korn; a, A. N. Anderson.

46 E. 14th St., alterations to 6-story br. and stone store and loft bldg.; c, \$40,000; o, A. & F. Gebert and M. G. Thapin; a, Robt. T. Lyons.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Highland Park, Ill.—Watson & Hazelton, 305 Dearborn St., Chicago, it is stated, have prepared plans for a residence to be erected in Highland Park for Mrs. H. J. Bardwell, at a cost of \$60,000.

Canton, Ill.—Wm. Wolf, of Galesburg, it is reported, has prepared plans for the Presbyterian Church, which is to be erected here. Cost, \$15,000.

Chicago, Ill.—Chas. H. Thompson, it is stated, will erect a 3-story apartment house at Sunnyside Ave. and Dover St., to cost \$45,000.

A permit is stated to have been issued for the erection of a 1-story brick church, to be erected at 8700 Aberdeen St.

Thos. Bishop, 113 Adams St., is stated to have prepared plans for two 3-story apartment houses in Hyde Park, one to be erected at 53d St. and Prairie Ave. for A. R. Clark & Co., the second to be erected at Ellis Ave. and 42d St., for Clark & Trainer, at a total cost of \$250,000.

Chicago Heights, Ill.—The Roman Catholic Order of St. Benedict, with headquarters at Einsiedeln, Switzerland, is reported to be perfecting plans for the organizing of an order in Chicago Heights and erecting buildings to cost about \$1,500,000.

Streator, Ill.—Jos. Molitor, 160 Washington St., Chicago, is stated to have prepared plans for an edifice for the Congregation of St. Stephens R. C. Church, to be 60x130 ft. brick and erected here, at a cost of \$30,000.

Indianapolis, Ind.—A building permit, it is stated, has been issued for the main part of the superstructure of the building for the SS. Peter and Paul Cathedral which is to be erected at 14 and Meridian Sts. The cost of this part of the work is reported to be \$100,000.

Des Moines, Ia.—It is stated that plans are being prepared for a \$40,000 apartment house which is to be erected at 19th and Pleasant Sts., by Mrs. Katherine E. Frawley.

Shelbyville, Ky.—The Shelbyville & Ohio River Ry. Co. is stated to have announced that the company will construct an electric railway from Shelbyville to the Ohio River.

Holland, Mich.—Bos & Bolhuis, it is reported, have secured the contract to erect a residence for Geo. Poole, to cost \$18,000.

Hoboken, N. J.—It is stated that bids will be received until Sept. 11 by Ross & Booraem, archts., 47 Cedar St., New York City, for erecting a 3-story brick and stone residence, 39 x 50 ft., for Mrs. A. Behrens, of Hoboken.

Philadelphia, Pa.—It is stated that A. Whitehead will erect a residence and garage for C. J. Swain, at 44th and Spruce, at a cost of \$57,800.

York, Pa.—Hamm & Leber, Wiest Bldg., it is stated, are preparing plans for a new edifice for the St. Matthew Lutheran Church, which is to cost about \$15,000.

Charleston, S. C.—E. N. Wulbern, it is stated, is about to erect a \$10,000 residence. Archt., D. C. Barbot.

Beaumont, Tex.—It is stated that bids will be received by F. S. Glover, Archt., Houston, until Sept. 20 for erecting a Methodist church.

Palestine, Tex.—It is reported that plans and specifications have been completed for the Christian Church, which is to be erected at a cost of \$20,000.

Seattle, Wash.—Frederick Heath, of Tacoma, is reported to be preparing plans for an edifice to replace the St. Patrick's Church, recently destroyed.

NEW YORK, N. Y.

113 Broome St., 6-story br. and stone tenemt.; c, \$25,000; o, Louis Frank; a, Bernstein & Bernstein.

201 E. 27th St., 7-story br. and stone tenemt.; c, \$60,000; o, Jos. L. De Forest; a, Ernest Flagg.

94th St. and Amsterdam Ave., 6-story br. and stone tenemt.; c, \$65,000; o, Jos. Friedman; a, Bernstein & Bernstein.

100th St. and Central Park West, 4 6-story br. and stone tenemts.; total c, \$160,000; o, Sobel & Kean; a, John C. Watson.

Amsterdam Ave. and 72d St., 12-story br. and stone apartment house; c, \$800,000; o, Ripley Realty Co.; a, Mulliken & Moeller.

118th St. and 7th Ave., 2 6-story br. and stone tenemts.; total c, \$230,000; o, Friedman & Feinberg; a, Bernstein & Bernstein.

113 E. 126th St., 6-story br. and stone tenemt.; c, \$50,000; o, Epstein & Cohen; a, Bernstein & Bernstein.

138th St. and 5th Ave., 3 6-story br. and stone tenemts.; total c, \$105,000; o, Jos. Jacobson; a, Wm. C. Sommerfeld.

2005 Amsterdam Ave., 6-story br. and stone tenemt.; c, \$70,000; o, Louis K. Ungrich; a, Henry Anderson.

Audubon Ave. and 166th St., 2 6-story br. and stone tenemts.; total c, \$75,000; o, Cahn & Levy; a, Bernstein & Bernstein.

Hoffman and 187th Sts., 2 5-story br. tenemt.; c, \$90,000; o, Baron & Dorf; a, Chas. S. Clark.

Lorillard Pl. and 187th St., 5-story br. tenemt.; c, \$30,000; o, Baron & Dorf; a, Chas. S. Clark.

156th St. and Trinity Ave., 5 5-story br. tenemts.; total c, \$270,000; o, Thos. J. McCaul; a, Lorenz F. J. Weiher.

162d St. and Woodcrest Ave., 5 5-story br. tenemt.; c, \$75,000; o, Hartman & Horgan; a, Neville & Bagge.

Cauldwell Ave. and 156th St., 5 5-story br. tenemts.; total c, \$250,000; o, Jacob Seider and Morris Stator; a, Maximilian Zipke.

Crimins Ave. and St. Marys St., 3 5-story br. tenemts.; total c, \$95,000; o, Rankin Bros.; a, M. J. Garvin.

SCHOOLS.

Notes Arranged Alphabetically by States.

Redondo, Cal.—The citizens, it is stated, have voted in favor of issuing \$25,000 bonds for the purchase of a site and the erection of a high school.

Storrs, Conn.—The H. Wales Lines Co., of Meriden, Conn., has secured the contract for the erection

plumbing, heating and electric work for the brick and stone dormitory for the Conn. Agricultural College at Storrs, bids for which were opened on July 24. Davis & Brooks, archts., Phoenix Mutual Life Bldg., Hartford, Conn.

Chicago, Ill.—Dwight H. Perkins, 17 Van Buren St., it is stated, has prepared plans for a school to be erected on Avers Ave., at a cost of \$180,000.

Terre Haute, Ind.—The plans of J. G. Vrydagh, Naylor-Cox Bldg., are stated to have been accepted for the 19th Dist. School; estimated cost \$45,000.

Monticello, Ind.—The high school is reported destroyed by fire.

Terre Haute, Ind.—The plans of J. G. Vrydagh, Naylor-Cox Bldg., it is stated, have been accepted for the 19th Dist. school, which is to be erected at a cost of \$45,000.

Logan, Ia.—Bids will be received until Sept. 15 by the Bd. Dirs. of the Independent School Dist. (E. C. Longman, Secy.) for erecting a high school. Proudfoot & Bird, Archts., Des Moines.

Orono, Me.—The Horace Purinton Co., of Waterville, it is stated, has secured the contract to erect the Carnegie Library at the Univ. of Maine at \$39,914.

Detroit, Mich.—Bids will be received until Sept. 12 by the Bd. Educ. (Wm. J. Lee, Secy.) for furnishing materials and erecting a 15-room school, to be known as the John Monteith School, on Hibbard Ave.

Northfield, Minn.—The H. N. Leighton Co., 213 S. 6th St., Minneapolis, is stated to have received the contract for erecting the Laird Science Hall at Carleton College. The structure to be of brick and cost about \$50,000.

Poplar, Mont.—Bids will be received until Sept. 27 by C. B. Lohmiller, Supt. U. S. Indian Agency, Poplar, for furnishing and delivering, as required, about 18,000 ft. common boards; 27,000 ft. lumber; 3,000 ft. flooring; 7,500 ft. ceiling; 3,050 ft. of V 3 crimp steel roofing, etc., to repair agency and school buildings at Ft. Peck.

Glendive, Mont.—Bids will be received until Sept. 19 by the School Dist. No. 1 of Dawson County (H. J. Halvorsen, Clk., Dion Blk., Glendive) for erecting a 4-room, 2-story brick school, to cost about \$14,000.

Rochester, N. Y.—Bids will be received until Sept. 13 by the Bd. Contract and Supply (F. X. Pifer, Clk.) for remodeling No. 11 school. Chas. F. Crandall, Archt., 401 Ellwanger & Barry Bldg.

Sag Harbor, L. I., N. Y.—It is stated that a school will be erected at Sag Harbor; an election to be held on Oct. 26 to vote to purchase a site for the structure; probable cost of building \$100,000.

Akron, O.—The contract for erecting the North Hill School, bids opened Aug. 21, is stated to have been awarded to Geo. W. Carmichael & Co., 524 Hamilton Bldg., for \$42,500.

Munhall, Pa.—The citizens are stated to have voted to issue \$25,000 bonds for erecting a school.

Omro, Wis.—Bids will be received until Sept. 23 by the Bd. Dirs., Webster Manual Training School, for erecting a manual training school at this place.

Milwaukee, Wis.—It is stated that the Trus. of Marquette College are contemplating the enlarging of the college at a cost of about \$100,000.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Chicago, Ill.—The following are the bids received Sept. 1 by the Dept. Pub. Wks. for the collection and removal of garbage: (a) 1906 to 1907; (b) 1907 to 1908; (c) 1908 to 1909; (d) 1909 to 1910, and (e) 1910 to 1911: John Dowdle, Chamber of Commerce, a \$794,000, b \$480,000, c \$500,000, d \$570,000, and e \$540,000; American Reduction Co., Pittsburgh, Pa., a \$1,045,000, b \$940,000, c \$960,000, d \$980,000, and e \$995,000; Dailing & Co., a \$743,000, b \$743,000, c \$743,000, d \$743,000, and e \$743,000.

Indianapolis, Ind.—All bids opened on Aug. 21 by the Bd. of Pub. Wks. for the removal, delivery and disposal of garbage and dead animals are stated to have been rejected. No action has as yet been taken with regard to the bids opened at the same time for the collection and disposal of ashes.

New York, N. Y.—Bids will be received until Nov. 6 by J. McG. Woodbury, Comr. Street Cleaning, for the final disposition of garbage in the Boro. of Manhattan for 5 years, from Aug. 1, 1906, as advertised in The Engineering Record.

Philadelphia, Pa.—The Webster Engr. Co., of Williamsport, is reported to have secured the contract to design, furnish and install the entire outfit of conveying machinery, to be used by the Penn. Reduction Co., the reported successful bidders for the garbage contract in Philadelphia; the machinery will cost about \$15,000.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

The Diamond Mills, Hudson, N. Y., have recently been sold to Mr. Guy M. Hoes. The plant is to be used as a toilet paper factory, necessitating the installation of entirely new equipment. New boiler and engines will also be installed.

The Publishers' Paper Co., Woodstock, N. H., it is reported, will shortly begin the erection of a large saw mill.

McEwen Bros., Whippany, N. J., have purchased the site of the old Eden Paper Mills, it is reported, and will erect two single board mills having a large capacity.

The West Ware Paper Co., Ware, Mass., will shortly begin work on new building to replace the one recently burned. The new building, it is reported, will measure 60 x 400 ft., and will be equipped with modern machinery.

The Case & Marshall Paper Co., Woodland, Conn., is erecting a 60 x 100 ft. addition to its plant.

S. D. Warren & Co., Westbrook, Me., have purchased site for extensive addition to their plant.

The Port Richmond (N. Y.) Hygeia Ice & Cold Storage Co. will build a 20-ton ice plant on the block system, the main engine to drive the ammonia compressors to be

of the compound Corliss type supplied with steam at a pressure of 125 lbs. by an internally-fired boiler of the Scotch type.

The Houston (Tex.) White Brick Co. will shortly purchase and install additional presses.

The Conley Mfg. Co., Clyde, Ill., makers of enameled cooking utensils, contemplates building two new furnaces in the near future.

F. E. Meyers & Bro., Ashland, O., are adding a 2000 70-ft. foundry and a 50x290-ft. machine shop and warehouse to their plant. No additional power plant will be required.

A. T. Steffans & Co., Newark, N. J., manufacturers of saddlery hardware, have let contracts for brick additions of the following sizes: 4-story, 50x75 ft.; 3-story, 50 ft. square; 2-story, 25x30 ft., to be equipped with freight elevators, steam heating and electric lighting, according to local newspaper reports.

The oil mill of the American Linseed Oil Co., at Omaha, Neb., which was recently burned with a loss of \$45,000, will be reconstructed at once, according to local newspaper reports.

The Western Copper Mfg. Co. has bought a 10-acre tract at Indiana Harbor, Ind., on which it will erect a plant to cost \$750,000, according to local newspaper reports. It is stated that the plant will include a copper and brass rolling mill and a tube and bar mill.

The Iroquois Furnace Co., Chicago, Ill., will begin in a few weeks the construction of a blast furnace to cost \$1,000,000, according to local newspaper reports.

The Baltimore & Ohio R. R. will erect a grain dryer to cost between \$30,000 and \$40,000 near its elevators at Locust Point, Md., according to local newspaper reports.

Wm. Steele & Sons, Philadelphia, Pa., have been awarded contract for a 2-story, 85x150-ft. brick and stone addition, to cost \$90,000, to the plant of the Schaum & Uhlinger Co., at Second St. and Glenwood Ave., according to local newspaper reports. It is also reported that Wm. Steele & Sons have invited estimates for a power plant to contain 15,000 h.p. in engines for the plant of the Lehigh Mfg. Co., at 22nd St. and Lehigh Ave., Philadelphia.

The William Pfeiffer Weiss Beer Co., Chicago, Ill., has bought a site on which to erect a plant, to cost \$100,000, according to local newspaper reports.

It is reported that the East St. Louis (Ill.) Ice & Cold Storage Co. has been incorporated with a capital of \$80,000 to erect an ice and cold storage plant. Daniel Sullivan is stated to be one of the incorporators.

It is reported that a 3-story addition, to cost \$30,000, is to be built to the plant of the Fisk Rubber Co., Chicopee Falls, Mass. Kirkham & Parlett, Springfield, Mass., archts.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Los Angeles, Cal.—Bids will be received until Sept. 30 by the Superv. Engr., U. S. Reclamation Service, Los Angeles, for furnishing from 30,000 to 40,000 bbls. of Portland cement, as advertised in The Engineering Record.

Washington, D. C.—Pawling & Harnischfeger have secured the contract for the 15-ton traveling crane, bids for which were received Aug. 21, at \$7,000.

Bids will be received at the Bureau Supplies and Accounts, Navy Dept., Washington, until Oct. 3, for furnishing at the Navy Yard, Mare Island, Cal.; Puget Sound, Wash., and Naval Training Station, San Francisco, Cal., a quantity of naval supplies, as follows: Brick; iron; pipe fittings; drills; brass; Jenkins valves; cement; electric fixtures, etc., also Oct. 10, at the navy yards, Boston, Mass.; New York, N. Y.; League Island, Pa., and Pensacola, Fla., a quantity of machine tools, etc., including rock-crushing plant; drilling and boring, engraving, pipe bending, milling and hydraulic shaft straightening machines; boring and turning mill, and radial drills. H. T. B. Harris, Paymaster-Gen., U. S. N.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Honolulu, H. I.—The contract to construct a wharf landing and wall at Quarantine has been awarded to Cotton Bros., San Francisco, Cal., at \$48,624.

Chicago, Ill.—Bids will be received until Sept. 13 by the Dept. Pub. Wks. (Jos. M. Patterson, Comr.) for constructing approximately 78 ft. dock, including the removal of old dock, at the west end of E. Washington St.; also about 40 ft. of dock at the east end of Fulton St., including the removal of old dock.

Plans for connecting the South Park and Lincoln Park systems, it is reported, have now so far advanced that D. H. Burnham & Co., Ry. Exchange Bldg., are ready to let contracts. The plans include the widening of Michigan Boule. and avenue to a width of the roadway of 125 ft., together with masonry approaches at Randolph St. on the south and Ohio St. on the north. The plans for the connecting bridge, which is to be of the bascule type, are being prepared by Karl J. Lehmann and provide for 270 ft. between trunnions, 220 ft. between protection piers and 77 ft. wide.

Indianapolis, Ind.—Bids will be received until Sept. 18 by the Bd. Comrs. (John McGregor, Chmn.) for constructing a concrete retaining wall on Michigan Road, Central Township.

Baltimore, Md.—Maj. Jos. W. Shirley, Engr. of the Topographical Survey Conn., it is stated, is making a survey of the valley of Gwynns Falls, from Dickeyville to Spring Garden. The survey is being made for the Park Bd., which is preparing to take up the question of extending Gwynn's Falls Park. The extension is to be made out of the \$1,000,000 park improv. loan which becomes available next year.

Holland, Mich.—Bids will be received Oct. 4 by Col. M. B. Adams, Corps Engrs., U. S. A., Grand Rapids, for extension of piers at Holland, as advertised in The Engineering Record.

Kearny, N. J.—Bids will be received until Sept. 27 by the Police Com. (J. J. Donnelly, Chmn.) for a police telephone system, as advertised in The Engineering Record.

**New York, N. Y.*—The following are the bids opened on Sept. 1 by the Dept. of Docks and Ferries for dredging about 100,000 cu. yds. in East and Harlem Rivers (price given per cu. yd.): Augustin Walsh, 26 Water St., 28 cts.; Henry DuBois Sons Co., 17 State St., 25 cts.; P. Sanford Ross, Inc., 277 Washington St., Jersey City, N. J., 21.9 cts.; R. C. Packard Co., 130 Pearl St., 21.7 cts.; The W. H. Beard Dredging Co., 21 State St., 21 cts.; total \$21,000 (awarded contract).

**Auburn, N. Y.*—Jos. Dunfee, of Syracuse, is stated to have secured the contract for constructing a subway on Clark St., for about \$18,000.

Cincinnati, O.—Bids will be received until Oct. 6 by the Bd. Co. Comrs. for furnishing material and installing electric elevators at the Hamilton Co. Court House; Eugene L. Lewis, Co. Aud.

Marysville, O.—\$30,000 county ditch construction bonds, it is stated, have been sold.

Van Wert, O.—It is reported that bids will be received Sept. 18 for \$18,000 ditch improvement bonds.

It is stated that bids will be received until Sept. 26 by W. H. Troupe, Co. Aud., for constructing Little Auglaize ditch; probable cost, \$10,000.

Dayton, O.—It is stated that bids will be received until Sept. 12 by the Bd. Pub. Service (Wm. F. Miller, Clk.) for constructing a concrete dam across the Great Miami River in Riverdale.

Philadelphia, Pa.—Bids will be received until Sept. 23 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Washington, D. C., for dredging and filling in the reserve basin, Navy Yard, League Island; appropriation available, \$77,000.

Spearfish, S. D.—Richard B. Hughes, Gen. Mgr. Black Hills Traction Co., writes that the McLaughlin Tie & Timber Co. secured the contract for constructing $5\frac{1}{2}$ miles of canal (bids opened Aug. 26) at the following bid: 190,000 cu. yds. earth excav., $12\frac{3}{4}$ cts.; 15,000 cu. yds. rock excav., 80 cts.; 50,000 cu. yds. overhaul, $1\frac{1}{4}$ cts., and 200 cu. yds. drystone culverts, \$3.50.

Norfolk, Va.—Bids will be received until Oct. 3 at the Bureau Supplies and Accounts, Washington, D. C., for dredging about 10,000 cu. yds. of mud, sand, clay, etc., at the navy yard, Norfolk.

Cape Hatteras.—Plans have been submitted to the Dept. of Commerce and Labor at Washington, D. C., for a light house, which Elabert & Ells, of Boston, Mass., intend constructing at Diamond Shoals, off Cape Hatteras. If the company is successful in constructing this light-house the government is to pay \$750,000. It is proposed to construct a foundation in a steel caisson, which shall be built and then floated to the point where it is proposed to erect the lighthouse. This steel caisson, sunk in the sand, will project 30 ft. above the water and will be filled with cement, sand and stone. On this foundation the lighthouse will be built to a height of 200 ft. The act of Congress provides that the lighthouse shall be built within 5 years and in successful operation for one year before purchased by the government.

Two Rivers, Wis.—Bids will be received until Sept. 13 by the Bd. Pub. Wks. (R. H. Suettinger, Chmn.) for constructing approximately 76 ft. of dock, extending from the harbor pier northerly along the east side of the East Twin River to Walnut St. The work includes the tearing up of the old dock, excavating, building and refilling new dock; piles will be furnished by the city, but all other materials must be furnished by the contractor.

Tacoma, Wash.—It is stated that the dredging of the Puyallup waterway for which the Government has \$240,000 available, is under consideration.

PROPOSALS OPEN

For Proposals see pages 22, 56, 60, 63, 65

WATER WORKS.

Bids Close.		See Eng. Record.
Sep. 12.	Water Wks., Franklin, Tenn.	Sep. 2
	Adv. Sept. 2.	
Sep. 12.	Pump, engines, Buffalo, N. Y.	Sep. 2
Sep. 12.	Ext'n. system, Arlington Heights, Ill.	Sep. 9
Sep. 13.	System, Southern Pines, N. C.	Aug. 19
Sep. 13.	Settling basins, St. Louis, Mo.	Sep. 2
Sep. 13.	Pipe, Chicago, Ill.	Sep. 9
Sep. 14.	Pumping machinery, Columbus, O.	Aug. 5
	Adv. Aug. 5 to Sep. 9.	
Sep. 14.	System, Shawnee, Okla. Ter.	Aug. 26
	Tank, etc., Ft. Myer, Va.	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Sep. 15.	C. I. pipe, etc., Cincinnati, O.	Sep. 2
Sep. 16.	Tower, Montgomery, Minn.	Sep. 9
Sep. 18.	C. I. Pipe, Victoria, B. C.	Aug. 19
Sep. 18.	Intake, Albany, N. Y.	Sep. 9
Sep. 19.	Pumps, etc., Toronto, Ont.	Aug. 5
	Adv. Aug. 5 to 19.	
Sep. 19.	Pump, engine, Burlington, N. J.	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Sep. 21.	Pump, sta., Galveston, Tex.	Aug. 26
	Adv. Aug. 26 to Sep. 2.	
Sep. 25.	Water wks., Glendive, Mont.	Aug. 26
Sep. 25.	System, Crambury, N. J.	Sep. 9
	Adv. Sep. 9.	
Sep. 26.	Tunnel, Montrose, Colo.	Aug. 12
	Adv. Aug. 12 to Sep. 9.	
Sep. 28.	Tank, Vancouver Barracks, Wash.	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Sep. 29.	Filters, etc., Cincinnati, O.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	
Sep. 29.	Boiler, wells, etc., Ft. Screven, Ga.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	
Sep. 30.	Pipe laying, Perth Amboy, N. J.	Aug. 26
Sep. —	Water Wks., E. Grand Forks, Minn.	Aug. 19
Sep. —	Water works, Jackson, Mo.	Aug. 19
Sep. —	Reservoir, McLeansboro, Ill.	Aug. 26
Oct. 3.	System, Shoshone Agency, Wyo.	Sep. 9
Oct. 12.	Sale of standpipe, Attleboro, Mass.	Jul. 29
	Adv. Jul. 29 to Aug. 5.	
Oct. 17.	Embankment, Roswell, N. M.	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Oct. 18.	Water Wks., Milledgeville, Ga.	Sep. 9
	Adv. Sep. 9.	
Oct. 26.	Dams, canals, etc., Belle Fourche, S. D.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	

SEWERAGE AND SEWAGE DISPOSAL.

Sep. 12.	Nevada, Mo.	Aug. 26
Sep. 12.	Chicago, Ill.	Sep. 9

Sep. 12.	Dayton, O.	Sep. 9
Sep. 12.	Youngstown, O.	Sep. 9
Sep. 13.	Lexington, Ky.	Aug. 26
	Adv. Aug. 26 to Sep. 2.	
Sep. 13.	Brooklyn, N. Y.	Aug. 26
Sep. 13.	Chicago, Ill.	Sep. 2
Sep. 13.	Ft. McIntosh, Tex.	Sep. 2
Sep. 13.	Sewers, St. Louis, Mo.	Sep. 2
Sep. 13.	Chicago, Ill.	Sep. 9
Sep. 13.	Lorain, O.	Sep. 9
Sep. 13.	Cincinnati, O.	Sep. 9
Sep. 13.	Altoona, Pa.	Sep. 9
Sep. 14.	Shawnee, Okla. Ter.	Aug. 26
Sep. 14.	Des Moines, Ia.	Sep. 2
Sep. 14.	Reading, Pa.	Aug. 26
Sep. 15.	Ft. Worth, Tex.	Sep. 2
Sep. 15.	Rushford, Minn.	Sep. 2
Sep. 15.	Cleveland, O.	Sep. 9
Sep. 15.	Columbus, O.	Sep. 9
Sep. 15.	Indianapolis, Ind.	Sep. 9
Sep. 18.	Indianapolis, Ind.	Sep. 2
Sep. 18.	Carroll, Ia.	Sep. 9
Sep. 19.	Southern Pines, N. C.	Aug. 19
Sep. 19.	New York, N. Y.	Sep. 9
Sep. 20.	Salem, O.	Sep. 2
Sep. 21.	Cincinnati, O.	Sep. 2
Sep. 22.	Cincinnati, O.	Sep. 2
Sep. 23.	Chicago, Ill.	Sep. 9
	Adv. Sep. 9.	
Sep. 25.	Glendive, Mont.	Aug. 26
Sep. 26.	Wenatchee, Wash.	Sep. 9
Sep. 27.	Virginia, Minn.	Sep. 9
Sep. 27.	Haddonfield, N. J.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	
Oct. 3.	Shoshone Agency, Wyo.	Sep. 9
Oct. 10.	Norristown, Pa.	Sep. 9
	Adv. Sep. 9.	

BRIDGES.

Sep. 11.	Newark, N. J.	Sep. 9
Sep. 14.	Boston, Wyo.	Sep. 9
Sep. 15.	Delaware, O.	Sep. 2
Sep. 15.	New Philadelphia, O.	Sep. 2
Sep. 16.	Washington, D. C.	Aug. 26
	Adv. Aug. 26 to Sep. 2.	
Sep. 16.	New Philadelphia, O.	Sep. 2
Sep. 16.	Pine, Idaho	Sep. 9
Sep. 18.	Indianapolis, Ind.	Sep. 9
Sep. 18.	Winona, Minn.	Sep. 9
Sep. 19.	Hartford, Conn.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	
Sep. 19.	Upper Sandusky, O.	Sep. 2
Sep. 23.	Cleveland, O.	Sep. 9
Sep. 25.	Washington, D. C.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	
Sep. 26.	Mankato, Minn.	Sep. 9
Sep. 29.	Springfield, O.	Sep. 9
Sep. 29.	San Juan, Porto Rico (2 prop.)	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Oct. 1.	Pensacola, Fla.	Aug. 12
Oct. 2.	Port Orchard, Wash.	Sep. 2
Oct. 2.	Pecunia, Ill.	Sep. 9
Oct. 3.	Bernadine, La.	Sep. 2
Oct. 4.	Superstructure, Chicago, Ill.	Aug. 12
Oct. 4.	Substructure, Chicago, Ill.	Aug. 12
	Minnesota City, Minn.	Sep. 9

PAVING AND ROADMAKING.

Sep. 11.	Springfield, O.	Sep. 9
Sep. 12.	Crookston, Minn.	Aug. 26
	Adv. Aug. 26 to Sep. 2.	
Sep. 12.	Green Bay, Wis.	Sep. 2
Sep. 12.	Rockville, Md.	Sep. 2
Sep. 12.	Chillicothe, O.	Sep. 2
Sep. 13.	Brooklyn, N. Y.	Sep. 2
Sep. 13.	Indianapolis, Ind.	Sep. 2
Sep. 13.	Chicago, Ill.	Sep. 9
Sep. 14.	Brazil, Ind.	Sep. 2
Sep. 14.	Towson, Md.	Sep. 2
Sep. 14.	Guilford, Conn.	Sep. 9
Sep. 15.	Cincinnati, O.	Aug. 10
Sep. 15.	Brownstown, Ind.	Sep. 2
Sep. 15.	Indianapolis, Ind.	Sep. 9
Sep. 16.	Ottawa, O.	Sep. 2
Sep. 18.	Willoughby, O.	Aug. 26
Sep. 18.	Napoleon, O.	Sep. 2
Sep. 18.	Lima, O.	Sep. 2
Sep. 18.	Columbus, O.	Sep. 9
Sep. 19.	Wilmington, Del.	Sep. 9
Sep. 19.	New York, N. Y.	Sep. 9
Sep. 20.	Freeport, Ill.	Sep. 9
	Adv. Sep. 9.	
Sep. 22.	Madisonville, O.	Sep. 2
Sep. 23.	Little Rock, Ark.	Sep. 2
Sep. 26.	Cleveland Heights, O.	Sep. 2
Sep. 27.	Cincinnati, O.	Sep. 9
Sep. —	Macon, Mo.	Sep. 9
Oct. 2.	Johnstown, N. Y.	Sep. 9
Oct. 4.	Steelton, Pa.	Sep. 2
	Adv. Sep. 2 to Sep. 9.	

POWER, GAS AND ELECTRICITY.

Sep. 12.	Washington, D. C.	Sep. 2
Sep. 15.	La Grange, Ga.	Aug. 26
	Adv. Aug. 12 to 26.	
Sep. 15.	Warren, Pa.	Sep. 9
Sep. 15.	Wynnewood, Pa.	Sep. 9
Sep. 18.	Ft. Myer, Va.	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 19.	Washington, D. C.	Aug. 26
Sep. 19.	Toledo, O.	Sep. 9
Sep. 19.	Washington, D. C.	Sep. 9
Sep. 27.	Baltimore, Md.	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 30.	Washington, D. C.	Aug. 5
	Adv. Aug. 5.	
Oct. 1.	Tacoma, Wash.	Jul. 8
Oct. 4.	Troy, Ala.	Sep. 2
Oct. 4.	Jacksonville, Fla.	Sep. 2
Oct. 11.	Lockport, Ill.	Aug. 19
Oct. 11.	Reading, O.	Aug. 26
Nov. 1.	Chicago, Ill.	Sep. 9
Dec. 2.	San Juan, Porto Rico.	Aug. 19

BUILDINGS.

Sep. 11.	Dwelling, Hoboken, N. J.	Sep. 9
Sep. 12.	School, Washington, D. C.	Sep. 2
Sep. 12.	Pub. Bldg., Seattle, Wash.	Sep. 2
Sep. 12.	Iron balconies for hospital, New York, N. Y.	Sep. 2
Sep. 12.	School, Galesville, Wis.	Sep. 2

Sep. 12.	Steam Htg. Pub. Bldg., Chicago, Ill.	Sep. 9
Sep. 12.	School, Detroit, Mich.	Sep. 9
Sep. 12.	Post Bldg., Ft. Williams, Me.	Sep. 9
Sep. 12.	Pub. bldg., Jersey City, N. J.	Sep. 9
Sep. 13.	Pub. Bldgs., Baltimore, Md.	Aug. 19
Sep. 13.	Engine house, Chicago, Ill.	Sep. 9
Sep. 13.	School, Rochester, N. Y.	Sep. 9
Sep. 13.	Pub. Bldg., New York, N. Y.	Sep. 9
Sep. 14.	Bus. bldg., St. Louis, Mo.	Aug. 5
Sep. 14.	Lighthouse, Ft. Schuyler, N. Y.	Aug. 12
	Adv. Aug. 12, 19.	
Sep. 14.	School, Shawnee, Okla. Ter.	Aug. 26
Sep. 14.	Pub. Bldg., New York, N. Y.	Sep. 9
Sep. 15.	Pub. bldg., material, Ft. Totten, N. Y.	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Sep. 15.	Bus. bldg., Okene, Okla. Ter.	Aug. 26
Sep. 15.	Bus. Bldg., Duncan, Ind. Ter.	Sep. 9
Sep. 15.	Plumbg., etc., Hosp., New York, N. Y.	Sep. 9
Sep. 15.	Logan, Ia.	Sep. 9
Sep. 15.	Bus. bldg., Hartford, Conn.	Sep. 9
Sep. 15.	Pub. bldg., Hartford, Conn.	Sep. 9
Sep. 16.	Pub. bldg., Cleveland, O.	Aug. 26
Sep. 16.	Pub. bldg., Chicago, Ill.	Sep. 2
Sep. 18.	Pub. bldg., Duluth, Minn.	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Sep. 18.	Pub. Bldg., Erie, Pa.	Aug. 26
Sep. 18.	Pub. Bldg., Winona, Minn.	Sep. 9
Sep. 18.	Add. to Hosp., San Jose, Cal.	Sep. 9
Sep. 18.	Bus. bldg., St. Louis, Mo.	Sep. 9
Sep. 19.	Capitol, Bismarck, N. D.	Aug. 19
Sep. 19.	Bldg. material, Crow Creek, S. D.	Sep. 2
Sep. 19.	School, Glendive, Mont.	Sep. 9
Sep. 20.	Court House, Akron, O.	Aug. 19
Sep. 20.	Schools, Jocko, Mont.	Sep. 2
Sep. 20.	Furnace, P. O., Washington, D. C.	Sep. 2
Sep. 20.	Church, Beaumont, Tex.	Sep. 9
Sep. 22.	School, Oneida, Wis.	Aug. 26
Sep. 22.	Storehouse, Ft. Hancock, N. J.	Sep. 9
	Adv. Sep. 9.	
Sep. 23.	School, Oniro, Wis.	Sep. 9
Sep. 24.	Freight house, Dayton, O.	Sep. 2
Sep. 27.	Bldg. material, Poplar, Mont.	Sep. 9
Sep. 27.	Pub. bldg., Middletown, N. Y.	Sep. 9
	Adv. Sep. 9.	
Sep. 28.	School, Washington, D. C.	Sep. 2
	Boiler, etc., Pub. Bldgs., Baltimore, Md.	Sep. 2
Sep. 29.	Post Bldgs., Ft. De Soto, Fla.	Sep. 9
Sep. 30.	Htg., etc., pub. bldg., Washington, D. C.	Aug. 5
Sep. 30.	Mess hall, etc., Washington, D. C.	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 30.	Pub. Bldg. New York, N. Y.	Sep. 2
Oct. 1.	Hospital, Memphis, Tenn.	Aug. 26
Oct. 1.	Fire headquarters, Kansas City, Mo.	Sep. 2
Oct. 2.	Repairing court house, Rosedale, Miss.	Aug. 26
Oct. 2.	Htg. jail, Cleveland, Miss.	Aug. 26
Oct. 4.	Pub. Bldgs., Ft. Wayne, Detroit, Mich.	Sep. 9
	Adv. Sep. 9.	
Oct. 4.	Post bldg., Ft. Riley, Kan.	Sep. 9
	Adv. Sep. 9.	
Oct. 5.	Courthouse, Manhattan, Kan.	Aug. 12
Oct. 12.	P. O. extension, Fargo, N. D.	Sep. 9
Oct. 16.	Court house, Gretna, La.	Sep. 2
	School, Santa Fe, N. M.	Sep. 2
	School, Lawrence, Kan.	Sep. 2
	Church, Ft. Worth, Tex.	Sep. 2

MISCELLANEOUS.

Sep. 12.	Crane, San Francisco, Cal.....	Aug. 12
Sep. 12.	Machine tools, etc., New Orleans, La.....	Aug. 12
Sep. 12.	Dredging, New York, N. Y.....	Aug. 19
	(2 prop.) Adv. Aug. 19 to Sep. 9.	
Sep. 12.	Cement, Panama.....	Aug. 26
Sep. 12.	Supplies, Washington, D. C.....	Sep. 2
Sep. 12.	Dam, Dayton, O.....	Sep. 9
Sep. 13.	Machine tools, etc., Panama.....	Aug. 19
Sep. 13.	Docks, Chicago, Ill.....	Sep. 9
Sep. 13.	Dock, Two Rivers, Wis.....	Sep. 9
Sep. 14.	Levee, England, Ark.....	Aug. 26
Sep. 14.	Jetty work, Newport, R. I.....	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 14.	Dredging, New York, N. Y.....	Sep. 2
Sep. 15.	Excav. canal, Riverston, Ala.....	Aug. 19
	Adv. Aug. 19 to Sep. 9.	
Sep. 15.	R. R. work, Charleston, W. Va.....	Sep. 2
Sep. 15.	Drain, Boone, Ia.....	Sep. 2
Sep. 16.	Hoist, New York, N. Y.....	Aug. 12
Sep. 18.	Sweeping machine, Sherman, Tex.....	Sep. 2
	Adv. Sep. 2.	
Sep. 18.	El. Ry. Woodland Cal.....	Sep. 2
Sep. 18.	Retain. wall, Indianapolis, Ind.....	Sep. 9
Sep. 19.	Supplies, Washington, D. C.....	Aug. 26
Sep. 19.	Ditch work, Council Bluffs, Ia.....	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 19.	Supplies, Washington, D. C.....	Sep. 9
Sep. 20.	Pier improv., Charlevoix, Mich.....	Aug. 26
	Adv. Aug. 26 to Sep. 9.	
Sep. 20.	Rock excav., Pawtucket, R. I.....	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 20.	Park work Baltimore Md.....	Sep. 2
Sep. 22.	Dam improv., Wheeling, W. Va.....	Aug. 26
Sep. 20.	El. Ry. borings, New York, N. Y.....	Sep. 9
	Adv. Sep. 9.	
Sep. 22.	Supplies, Panama.....	Sep. 2
Sep. 23.	Ditch, Des Moines Ia.....	Sep. 2
Sep. 23.	Dredging, Philadelphia, Pa.....	Sep. 9
Sep. 26.	Telephone, Washington, D. C.....	Sep. 2
Sep. 26.	Cement, Billings, Mont.....	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 26.	Elevators, Baltimore, Md.....	Sep. 2
	Adv. Sep. 2 to 9.	
Sep. 26.	Ditch, Van Wert, O.....	Sep. 9
Sep. 27.	Telephone system, Kearny, N. J.....	Sep. 9
	Adv. Sep. 9.	
Sep. 30.	Crane track, Boston, Mass.....	Sep. 2
Oct. 3.	Supplies, San Francisco, Cal.....	Aug. 26
Oct. 3.	Dredging, Norfolk, Va.....	Sep. 9
Oct. 3.	Supplies, Washington, D. C.....	Sep. 9
Oct. 4.	Piers exten., Holland, Mich.....	Sep. 9
	Adv. Sep. 9.	
Oct. 6.	Elevator, Cincinnati, O.....	Sep. 9
Oct. 10.	Supplies, Washington, D. C.....	Sep. 9
Oct. 25.	Dock, Chicago, Ill.....	Sep. 2
Nov. 6.	Garb. disp., New York, N. Y.....	Sep. 2
	Adv. Sep. 9.	
Nov. 9.	Wharf, etc., Havana, Cuba.....	Jul. 29
Dec. 1.	R. R. work, Manila, P. I.....	Sep. 2
Jan. 1.	Statue plans, Indianapolis, Ind.....	Jul. 29
Jan. 2.	06. Harbor Work, Valparaiso, Chili, Apr. 29	29
	Adv. Apr. 29 to Sep. 9.	
	R. R. work, Providence, Ky.....	Aug. 26
	Excav. Indianapolis, Ind.....	Aug. 26